British Columbia Chronic Wasting Disease Risk Assessment

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Executive Summary:

The goal of this risk assessment is to provide information that can be used to guide future decisions regarding chronic wasting disease (CWD) surveillance and management in British Columbia (B.C.). This risk assessment:

1) Provides an overview of the disease and its natural history.

2) Identifies what is at risk for B.C. should the disease be introduced.

3) Evaluates the surveillance effort in B.C. and estimates how confident the province can be that it is currently free of CWD.

4) Assesses the risk of CWD introduction into the province and evaluates the potential consequences should the disease be introduced.

5) Describes and assesses the current CWD response and management plan for B.C.

6) Provides recommendations to reduce the risk of CWD introduction into B.C. and mitigate some of the potential consequences should the disease be introduced.

CWD is a transmissible spongiform encephalopathy[1] (TSE) that affects both free-ranging and captive cervids. Currently, CWD is largely restricted to North America and causes a fatal disease in susceptible species (Williams and Young, 1993; Joly et al, 2003). Thus far elk, moose, mule deer, black-tailed deer and white tailed deer have been shown to be naturally susceptible to CWD (Williams 2005, Baeten et al 2007). All of these species are endemic in B.C.

Introduction of CWD into wild or captive cervids in B.C. could adversely affect human health and wellbeing in a variety of direct and indirect means. These may include changes to cervid population numbers and sustainability, associated environmental changes, economic consequences resulting from reduction in hunting or other nature-related activities, and impacts to cultural and traditional practices.

Since 2002, over 1000 samples have been collected from B.C. cervids and none have tested positive for CWD. With this level of surveillance, B.C. can state, with 95% confidence, that if the disease is present, the prevalence is below 1.2% (based on 2007 surveillance numbers). However, CWD detection through laboratory testing is not the only method to ensure freedom from disease. The fact that most of B.C.'s neighbouring jurisdictions have not detected CWD in their cervid populations further supports the assumption that B.C. is currently CWD-free. Only Alberta has detected CWD in wild cervids, and so far all cases have occurred in the south-east area of the province along the Saskatchewan border. Appendix 1 outlines current CWD status, and CWD related regulations in the provinces and states bordering B.C. ***Based on the disease status of neighbouring jurisdictions and because no positive CWD cervids have been***

[1] TSE's are progressive neurodegenerative disorders in animals and humans caused by transmissible agents that produce spongiform changes (microscopic holes) in the brain (APHIS, 2000).

detected to date in the province, B.C. can be confident that it is free from CWD at this time.

Direct animal to animal contact and indirect contact through environmental contamination are considered to be effective means of CWD transmission (Miller and Williams, 2003; Miller and Williams, 2004). Transmission dynamics within and between populations may be further compounded by animal movement (Salman, 2003; Samuel et al., 2003). ***The risk of CWD infection in wild cervid populations in B.C. is, therefore, primarily associated with the natural movement of CWD-positive animals from CWD endemic areas into the province***. The geographic separation between the CWD cases in Alberta and the B.C. border is sufficient to suggest that, presently, ***there is a low risk of CWD introduction into B.C. through movement of infected animals from Alberta.*** This risk, however, will change if there is any westward movement of CWD cases in Alberta, or if CWD is detected in any of the other provinces/states bordering B.C.

The areas of B.C. where CWD is most likely to be introduced are the Peace and Kootenay Management Regions that border Alberta. Presently, the number of cervids submitted and tested in the Peace Management Region is not adequate. ***In order to improve detection, surveillance efforts should be enhanced in north-eastern B.C.*** This can be accomplished through enhanced testing of animals exhibiting clinical symptoms compatible with CWD, including additional testing of road kill animals, and increasing the number of hunter-killed submissions. Should the CWD status in any of the neighbouring provinces/states change, further adaptations to the B.C. surveillance program will need to be considered. Additionally, education of hunters returning to B.C. from Alberta should be continued and expanded.

At this time, should a case of CWD be confirmed in a wild cervid, the B.C. Ministry of Environment Wildlife Veterinarian will supervise and coordinate any epidemiological investigations or response actions, whereas in the event that CWD is diagnosed in a captive cervid (both farmed and zoo/rehabilitation animals), the CFIA and members of B.C. CWD Technical Group would lead further investigations, depopulations and quarantines***. In order to improve the efficacy and efficiency of response actions in the event of a CWD diagnosis in B.C., we recommend that communication between all parties be improved and formalized.*** This should include the maintenance of up-to-date contact information, as well as the development of more concrete roles and responsibilities for the various parties. Finally, we believe that it would be extremely beneficial to document and collate the locations of all captive cervids in the province (including those is zoological, rehabilitation and research facilities) in order to identify potential routes of iatrogenic CWD spread into B.C., and to facilitate response efforts should CWD be found in a captive cervid in the province. A summary of the identified risks and accompanying recommendations are provided in the following table.

A summary of CWD risks and recommendations for B.C

Risk	Recommendations
CWD detection ability among populations of free ranging cervids.	Focus surveillance efforts along B.C.-Alberta border, particularly in the Peace Region to improve detection ability.
	Develop and maintain a process for open and frequent communication about CWD with all neighbouring jurisdictions. This will allow B.C. to adapt its CWD surveillance and response plan in relation to changing CWD prevalence in surrounding areas to maximize disease detection ability (note that this applies equally to CWD infection in wild and captive cervids).
	Evaluate detection plans annually in light of how the risk status of neighbouring jurisdictions changes.
Introduction of CWD into B.C. through movement of CWD infected wild cervids and parts.	Continue and increase hunter education/awareness about risks associated with movement of carcasses/carcass parts.
CWD detection ability among captive cervid populations	Improve understanding of where all captive cervids are located – including zoo and research animals.
Introduction and spread of CWD through movement of farmed cervids.	Maintain current strict import and export regulations and game farming protocols.
Ability of B.C. to initiate a timely response should CWD be detected in wild or captive cervids in the province.	Formalize communication, update contact information and develop roles and responsibilities for the various parties potentially involved in CWD response before the disease is detected.

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Part I: Risk Assessment Request and Background

In the summer of 2007, the provincial wildlife veterinarian (Ministry of Environment) for British Columbia (B.C.) requested a risk assessment of Chronic Wasting Disease (CWD) for the province. The focus of the assessment was 1) to describe what is being done in B.C. to prevent and monitor for this emerging wildlife disease; 2) compare the B.C. surveillance, monitoring and response plans with other jurisdictions; and 3) identify where weaknesses in the current program exist.

The goal of this risk assessment is to provide information that can be used to guide future decisions regarding CWD surveillance and management in the province. In this risk assessment, the Center for Costal Health (CCH):

1) Provided an overview of the disease and its natural history
2) Identified what is at risk for B.C. should the disease be introduced
3) Evaluated the surveillance effort in B.C. to provide an estimate of how confident the province can be that it is currently free of CWD
4) Assessed the risk of CWD introduction into the province and evaluated the potential consequences should the disease be introduced
5) Described and assessed the current CWD response and management plan for B.C.
6) Provided recommendations to help reduce the risk of CWD introduction into B.C. and mitigate some of the potential consequences should the disease be introduced

Work on the risk assessment commenced in the fall of 2007. The expected delivery of the final risk assessment is late winter 2008.

This is a qualitative risk analysis. As with most diseases of wildlife, the data required to build a plausible quantitative risk model for CWD are lacking. Without such information the estimates generated from a quantitative approach will have wide confidence margins, and there will be little certainty about the range of potential outcomes.

Part II: What is CWD?

CWD is a transmissible spongiform encephalopathy[2] (TSE) that affects both free-ranging and captive cervids. CWD is largely restricted to North America and causes a fatal disease in susceptible species (Williams and Young, 1993; Joly et al, 2003). In affected jurisdictions, CWD has had a significant impact on the game farm industry, resulted in considerable public investment, and raised concerns about its potential effect on wildlife conservation efforts (Salman, 2003; Kahn et al*,* 2004; Peterson, 2005). The proposed transmissible agent of CWD is an abnormally conformed protein called a prion, referred to as PrP^{CWD} or CWD prion (Dormont, 2002). In recent years, there has been heightened interest in CWD due to potential links between bovine spongiform encephalopathy (BSE), also a prion disease, and variant Creuztfeld-Jacob Disease (vCJD) in people (Salman, 2003).

Susceptible Species

CWD is only known to infect animals belonging to the family cervidae. Known susceptible cervid species include (Williams & Young, 1992; Williams and Miller, 2002; CDOW, 2006; Kreeger et al, 2006):

- White-tailed deer (WTD) (*Odocoileus virginianus*)
- Mule deer (*Odocoileus hemionus*)
- Black-tailed deer (*Odocoileus hemionus columbianus)*
- Rocky Mountain elk (*Cervus elaphus nelsoni)*
- Moose (*Alces alces*)
- Mule deer and white-tailed deer hybrids

The full spectrum of susceptible species is not yet known, and subspecies of those listed above should be considered susceptible to CWD despite a current lack of supporting evidence (Miller and Williams, 2004). For the purposes of this risk assessment all cervid species are considered potentially susceptible to CWD. This includes fallow deer (*Dama dama*) and reindeer (*Rangifer tarandus*), the two cervid species that are farmed in B.C., but in which CWD has not yet been documented. There is some evidence to suggest that fallow deer may be more resistant to CWD infection then other cervid species. Research has indicated that although CWD can be transmitted to fallow deer through intracerebral inoculation, it is improbable that natural transmission of CWD would come about in the normal lifespan of deer of this species (Hamir et al., 2007). Research into the natural susceptibility of fallow deer to CWD is ongoing.

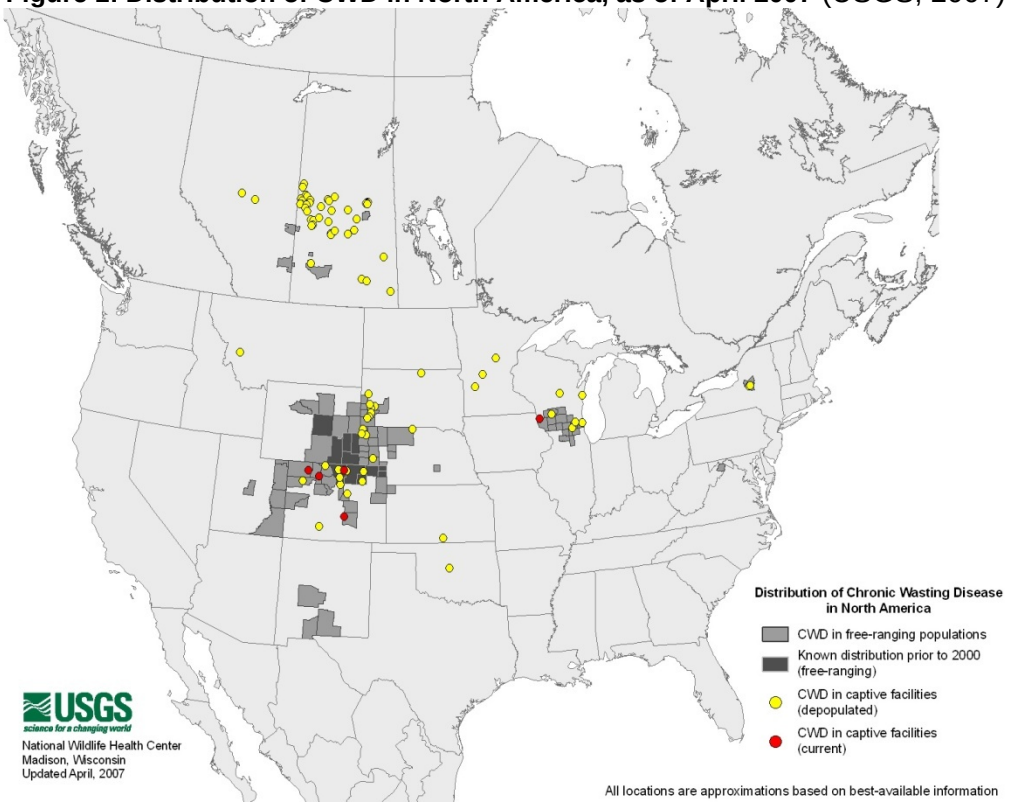
CWD History and Distribution

CWD was first described in the 1960s in captive mule deer held in research facilities in northern Colorado. Originally thought to be caused by stress, poor nutrition or intoxication, CWD was first recognized as a TSE in 1978 (Williams and Young, 1980). These earliest cases occurred in a group of animals that originated from several sources, including free-ranging populations.

[2] TSE's are progressive neurodegenerative disorders in animals and humans caused by transmissible agents that produce spongiform changes (microscopic holes) in the brain (APHIS, 2000).

At present, CWD has been diagnosed in two Canadian provinces and 14 American states (Figure 1). Saskatchewan, Alberta, Colorado, South Dakota, Kansas, Nebraska, New York and Wisconsin have detected CWD in both free-ranging and captive populations; Illinois, Utah, West Virginia, Wyoming and New Mexico have diagnosed CWD in free-ranging cervids only; and Minnesota, Montana, and Oklahoma have found CWD in captive cervids only (CWD Alliance, 2007[3]). Of the provinces/territories and states that border B.C., only Alberta and Montana have diagnosed cases of CWD, while the Yukon, Northwest Territories, Alaska, Idaho and Washington remain negative (CWD Alliance, 2007).

Figure 1: Distribution of CWD in North America, as of April 2007 (USGS, 2007)



Korea is the only country outside of North America to have diagnosed CWD. The Korean case was traced back to a captive elk imported from Canada (Sohn et al, 2002; Kim, 2005) and no indigenous cases have been reported (Kataoka, 2004). Few countries outside of North America routinely conduct CWD surveillance, with the exception of several European countries (Belgium, Denmark, Germany, Italy, Finland, Sweden, UK and Spain) and Japan (EFSA, 2004; Bosschere, 2005; Roels, 2005; Kataoka, 2004). There is a possibility of unrecognized CWD outside of North America, but such an occurrence is purely speculative at this time. For this risk assessment, we considered CWD to be a uniquely North American disease.

[3] http://www.cwd-info.org/ Accessed December 2007.

CWD Pathogenesis and Transmission

The natural history of CWD is not completely understood, but differs from other prion-associated diseases, such as scrapie and BSE, by its occurrence in both captive and free-ranging cervid populations. The clinical features of the disease are similar to other TSEs: behavioral changes, lowered head, drooping ears, loss of body condition, excessive salivation, difficulty swallowing and aspiration pneumonia. Classical CWD is characterized by behavioral changes and weight loss that can last for months. The clinical signs are nonspecific and can be easily confused with other diseases. Infected animals can have prolonged periods where they are asymptomatic, sub-clinical or have mild clinical signs. Signs of the disease can be more subtle in elk than deer; a feature that must be considered when developing surveillance programs (Williams, 2005).

PrP^{CWD} (CWD associated prion) enters, amplifies and accumulates in gut-associated lymphoid tissues (GALT) prior to entry into nerve cells and subsequent invasion of the brain. As the disease progresses, PrP^{CWD} can be detected in multiple sites in central and peripheral nervous tissues, endocrine organs, and the alimentary lymph nodes (Williams and Young, 1993; Sigurdson et al, 1999a, 1999b and 2001; Williams et al, 2002). Distribution and levels of PrP^{CWD} in tissues can differ between species (elk versus deer) (Balachandran et al, 2002; Williams and Miller, 2002 ; Williams, 2005), thereby affecting which tissues can be used for testing (Spraker et al, 2004). A consistent diagnostic feature of CWD is the presence of marked spongiform lesions in the central nervous system (Williams, 2005).

In general, the incubation period ranges from 15 to 36 months, although animals less than 12 months of age have been diagnosed with CWD (Salman, 2003; Kahn, 2004; Williams, 2005). This long incubation period complicates surveillance and response planning, and the incubation period, survival time and clinical presentation of CWD are influenced by factors such as species, dose and type of inoculum, and the animal's environment (Belay et al, 2004; Williams et al, 2002). Once an animal has demonstrated clinical signs of the disease, death will normally occur within one year (Miller and Williams, 2004).

CWD is believed to have spread geographically through natural movement of free-ranging cervids, translocation of wild cervids, and movement of farmed cervids (Samuel et al, 2003; Miller et al, 2000; Gross and Miller, 2001; Williams et al, 2002 and Bollinger et al, 2004; Williams and Young, 1992; Miller and Williams, 2003 and 2004). The exact mechanism of CWD transmission is not known, but direct transmission through body secretions and indirect transmission via environmental contamination (i.e. carcasses, excreta) are highly suspected (Mathiason et al, 2006; Sigurdson et al, 1999a; Williams, 2001 and 2005; Miller et al, 1998). Research has shown that PrP^{CWD} is shed in bodily fluids such as saliva and blood (Mathiason et al, 2006). It has been speculated that blood-feeding insects could serve as vectors for transmission (Mathiason et al, 2006; Lupi, 2005); however confident causal conclusions regarding the role of blood-borne transmission have not yet been established.

Rates of infection vary among and between cervid species and populations, possibly due to differences in genetic determinants of susceptibility, rates of disease transmission, and/or social behaviors. Miller and Williams (2003) reported that CWD prevalence in free-ranging cervid populations could vary from less then 1% to more then 15%. Disease prevalence can also vary across species within a location. In the CWD

endemic area (south-eastern Wyoming and north-eastern Colorado), the proportion of positive animals was 4.9% in mule deer, 2.1% in white-tailed deer and 0.5% in elk (Miller et al, 2000). A higher prevalence of CWD in males than females has been described in several free-ranging populations (Miller et al., 2000; Miller and Conner, 2005; Kreeger, Pers. Comm. cited in Miller and Conner, 2005; unpublished data cited in Miller and Conner, 2005). This discrepancy may reflect variations in social and foraging behaviors and/or movement patterns between males and females (Miller and Conner. 2005).

In captive cervid populations, CWD appears to uniformly affect both sexes and all age groups (Cited in Miller and Conner. 2005; Salman, 2003). Disease prevalence is generally higher among captive cervids than in free-ranging animals, likely due to higher population densities in captive groups (Miller et al. 2000).

CWD can be transmitted between different susceptible cervid species. This has been supported both experimentally (Tamguney et al., 2006), and through evidence of CWD infection in sympatric[4] free-ranging populations of deer and elk (Miller et al, 2000). Transmission of CWD to non-cervid species has not been proven. Cattle, goats and sheep living with CWD-affected animals for prolonged periods of time did not develop the disease (Gould et al, 2003; Williams, 2001). Attempted oral transmission of the CWD prion from a cervid to cattle (Williams, 2001) and to ferrets (Perrott et al, 2004 cited in Bourne, 2004) has been unsuccessful. These results suggest the presence of a species barrier making transmission of CWD from cervids to other species difficult, particularly under natural conditions (Moore, 2005).

CWD Diagnosis

Diagnosis of CWD is made by examination of the brain for spongiform lesions (Williams and Young, 1993; Miller et al, 2000; Williams et al, 2002*;* Williams, 2005), with official confirmation requiring detection of PrP^{CWD} in the brain or lymphoid tissues by immunohistochemistry (IHC) (Miller and Williams, 2004). Consequently, a final diagnosis of CWD can only be made post-mortem and requires confirmation by the Canadian Food Inspection Agency (CFIA). The OIE has not set diagnostic standards for CWD (OIE, 2006). The sensitivity of IHC depends on the tissues being tested (Bollinger et al, 2004; Cited in Bourne, 2004).

Other CWD diagnostic techniques, including enzyme linked immuno-sorbant assays (ELISA) and Western Blot, are also being used by state agencies to screen for CWD in free-ranging animals. ELISA tests, including the BioRad® ELISA (brELISA), decrease turnover time for CWD diagnostics (5 days for the IHC versus 5 hours for the brELISA), and permit test automation, thus allowing large numbers of samples to be run in a short period of time and eliminating the need for highly trained personnel (Hibler et al 2003). The brELISA is a conventional sandwich ELISA that can be used to detect CWD prion protein in samples from the obex and retropharyngeal lymph nodes. The overall agreement between the brELISA and the traditional IHC test is greater then 97.6% for retropharyngeal lymph nodes and greater then 95.7% for obex samples (Hibler et al 2003). Additionally, the brELISA is equally sensitive compared to the IHC for detection of CWD in established infections, although it should be noted that neither test is completely accurate in subclinical cases where there is minimal PrP^{CWD} present (Hibler et al 2003).

[4] Sympatric: describing different species or populations that live in the same geographical area (Morris, 1992).

The Prionics® Western Blot test was used for a short time in B.C. to screen cervids for CWD (pers comm. J. Robinson, 2008). This test involves digestion of a brain sample in order to isolate abnormal prion protein, separation of the protein along a specialized membrane and identification of the protein using labeled antibody. Although the Western Blot method is commonly used to test for BSE, it has not yet been validated for CWD testing in cervids.

There is significant interest in developing a test for live animals because the long incubation period and reliance on postmortem test results limits early detection. New methods of diagnosis such as tonsillar biopsy are currently under development and are being used in limited situations (Wild et al, 2002; Bollinger et al, 2004; Schuler et al, 2005).

Part III: What is at risk for British Columbia?

Cervid populations of interest – what populations are at risk?

Free Ranging Cervids

B.C. has the greatest diversity of cervid species in Canada (Shackleton, 1999, cited in Garde and Schwantje, 2007), including Rocky Mountain elk, Roosevelt elk (*Cervus canadensis roosevelti*), moose, mule deer, black-tailed deer, white-tailed deer, and woodland caribou (*Rangifer tarandus caribou*). All of these native cervid species are believed to be susceptible or potentially susceptible to CWD (Williams 2005, Baeten et al 2007, Bollinger et al 2004). The most recent estimates (2003) of wild cervid numbers in B.C. are shown in Table 1. Population size estimates are based on information supplied by Regional Wildlife Biologists and include both plausible minimum and maximum estimations (Provided by the B.C. Ministry of Environment). Wild cervid populations are provincially managed by the B.C. Ministry of Environment under the B.C. *Wildlife Act*.

Table 1: British Columbia free-ranging cervid estimates (2003).

Species	Population estimates	
	Minimum	Maximum
Moose	130,000	225,000
Elk	39,500	56,000
Caribou	16,000	20,500
Coast black-tailed deer	115,000	200,000
Mule deer	105,000	175,000
White-tailed deer	65,000	91,000

In order to manage the provincial wildlife populations most effectively, B.C. is split into Management Regions (Figure 2). Each Management Region is then subdivided into Management Units. The estimated cervid population for each of the Management Regions is shown in Table 2.

Table 2: Estimated ranging cervid populations by Management Region (2003).

Management Region	Total Cervid Population Estimate (2003)	
	Minimum	Maximum
Vancouver Island	61710	103320
Lower Mainland	20310	34450
Thompson	33050	58050
Kootenay	84420	177550
Cariboo	39200	68250
Skeena	73750	126650
Omineca	36800	61500
Okanagan	61955	89915
Peace	59500	119000

Farmed Cervids

B.C. does not permit the farming or import of native cervid species (Government of B.C., ME, 2007a), but currently allows game farming of two cervid species: fallow deer and reindeer. Farming of fallow deer was conditionally approved in May 1987. Reindeer farming was approved in February 1988 for the Peace River Region only (Government

of B.C., MAL, 2007). This was expanded to other areas of the province in July 1993, with special conditions applying to areas of high caribou populations (Government of B.C., MAL, 2007).

Game farm numbers in B.C. are in decline. Based on numbers compiled from provincial governments, CFIA, Stats Canada and Cervid Association, there were 30 fallow deer farms (3295 animals in total) and 4 reindeer farms (100 animals in total) in B.C. at the end of 2005. This is down considerably from 1997 numbers: 15,000 fallow deer on 64 farms, and 200 reindeer on 19 farms (Garde and Schwantje, 2007). Currently, there are 24 fallow deer farms with a total of 2895 animals and 2 reindeer farms with approximately 50 animals (D. Sand, personal communication, 2008). Most of the fallow deer farms are in the Lower Mainland and Vancouver Island regions but the largest farms with the most animals are in the Thompson region. The reindeer farms are in the Peace Region. One farm has both reindeer and fallow deer. The BCMAL estimates that the number of licensed cervid farms decreases by approximately 10 farms per year (D. Sand, personal communication, 2008).

As mentioned above, susceptibility of fallow deer to CWD is still in doubt (Hamir et al., 2007). The apparent resistance of this species to CWD infection may mitigate the risk of CWD exposure to this sector of farmed cervids.

Cervids in Zoos, Rehabilitation and Research Centres

Cervid populations in zoological, rehabilitation and research facilities are not a major focus of this risk-assessment; however, they do warrant consideration as a potential route of introduction of CWD. In the 2001 Census of Agriculture (Statistics Canada), 7 elk “farms” were listed for B.C.; none were identified in the 2006 Census. Further enquiries revealed that all the elk “farms” counted in 2001 were herds held by zoos and wildlife parks in the province.

The B.C. Wildlife Act (1982) regulates capture and use of wildlife in B.C.; the act is currently under review). Under the act, elk can be held in captivity for the purpose of public display. By definition, the animals must be on display for at least 7 days out of every year. In order to operate, all zoos require a permit from the B.C. Ministry of Environment.

Figure 2: British Columbia Ministry of Environment's Management Regions (Government of B.C., ME, 2007b).

The 7 captive elk herds identified in the 2001 Census of Agriculture held a total of 341 animals. These herds were located in the following Management Regions:

Thompson (1 herd)
Kootenay (3 herds with 195 animals)
Cariboo (1 herd)
Peace (2 herds)

The number of elk herds currently permitted and held by zoos and wildlife parks in B.C. was confirmed with Regional Biologists in 2008 (Table 3).

Table 3: Number of elk herds and individual animals held in zoos and wildlife parks in B.C. in 2008.

Management Region	No of herds	No of animals	Regional Biologist
Vancouver Island	0	0	Karen Morrison
Lower Mainland	1	17 (as of winter 2007)	Chris Procter
Thompson	1	Approximately 2	Doug Jury
Kootenay	0	0	Irene Teske
Cariboo	0	0	Julie Steciw
Skeena	0	0	Rick Marshall
Omineca	0	0	Doug Wilson
Okanagan	0	0	Brian Harris
Peace	1	Approximately 10	Rob Woods

Why should the B.C. public care about CWD?

Introduction of CWD into wild or captive cervids in B.C. could adversely affect human health and well being in a variety of direct and indirect means. These may include changes to cervid population numbers and sustainability, associated environmental changes, economic consequences resulting from reduction in hunting or other nature-related activities, and impacts to cultural and traditional practices. Additionally, there is public concern about the safety of meat products derived from CWD positive animals and the potential for CWD to be transferred to people.

Based on currently available information, CWD is not transmitted from cervids to humans. There has been no documentation of humans contracting prion disease from cervids, either through consumption of infected carcasses or by direct contact with live, infected animals. A study in Wisconsin investigated 3 cases of degenerative neurologic disease in hunters and found no association between CWD and Creuztfeld-Jacob Disease (CJD) (MMWR 2003). Regardless, prudent use recommendations suggest that, as a precautionary measure, meat from infected animals should not be consumed.

Outdoor recreational activities, including hunting, are important to British Columbians. According to a report published by Environment Canada entitled "The importance of nature to Canadians: the economic significance of nature-related activities" (2000), in 1996, British Columbians spent $1.9 billion on nature related activities including accommodations, transportation, equipment, and supplies related to hunting, fishing, wildlife viewing and other nature-related activities. As a result of these activities it is estimated that over 34,000 jobs were supported and municipal and provincial governments received $618 million in revenue. In the same year, B.C. residents spent $99.5 million hunting wildlife (approximately 5% of all nature-related activity costs), and recreational hunting alone contributed $87.9 million to the gross domestic product. The survey found that B.C. hunters attributed a greater value to nature than other participants, based on the finding that each hunter contributed on average $271 per year.
Similar statistics but lower values were released in 2005 by the B.C. Ministry of Water, Land and Air Protection[5] (now Ministry of Environment). The different economic value of hunting in B.C. calculated in the two reports is likely due to differences in methodologies used as well as the declining number of hunters in the provinces. B.C. saw a decline in the number of resident hunters of about 25% between 1996 and 2003 (Mark Messmer, pers., comm., 2007). From 1997/98 to 2007, the number of basic hunting licenses sold dropped by 18% (2007 hunting report). Conversely, the number of non-resident licenses sold increased by 34% from 1997/98 to 2006/07. However, non-resident hunters represent of small fraction of the total hunters in B.C.

In the State of Wisconsin, the number of hunting licenses sold dropped by 10% in the year CWD was detected (Bishop 2004). Bishop (2002) estimated that Wisconsin hunters would lose $70-$100 million in recreational activity benefit due to CWD. However, the author notes that only $5-10 million would be lost directly to the economy. The other component would reflect non-market losses and this would be borne primarily by hunters (Bishop 2002). The author argues that the Wisconsin economy would likely not suffer tremendous losses because, as is the case in B.C., most hunters are local and thus if they choose not to hunt are still likely to spend their dollars in state. Since CWD has been detected in Wisconsin, these predictions have been confirmed. It is estimated that

[5] http://www.env.gov.bc.ca/fw/wildlife/hunting/docs/valueassoc_bc_wildlf.pdf: Accessed Dec 2007.

Wisconsin hunters lost $53-$79 million in 2002, the year CWD was detected. However, the total loss to the Wisconsin economy due to CWD detection did not exceed $5 million (Bishop 2004).

Other states/provinces have used similar estimates to determine the direct and indirect impact that CWD would have on their economies. In contrast to the Wisconsin assessment, an economic study prepared for the government of Ontario concluded that detection of CWD in the province could potentially have large and far reaching economic consequences depending on where the disease is detected and what response action is taken (Lazo et al, 2004).

It is also important to consider the intrinsic value placed on nature by the people of B.C. The potential negative effects of CWD on wild cervids and the ecosystems in which they live are not yet fully understood, yet some models have predicted that the disease may have profound, detrimental effects on infected populations (Gross and Miller 2001). However, these predictions have not to date been realized in regions where CWD is endemic in cervid populations. Additionally, CWD infection in wild herds also has potential negative consequences of both monetary and non-monetary value for First Nations people. Access to and use of wildlife have cultural importance to First Nations people and rural communities in B.C. in addition to providing an important source of food. What impact CWD would have on cervid populations in the province and how this would impact the sustainability of hunted populations remain uncertain.

CWD infection in farmed cervids also carries potential negative consequences for the province. CWD diagnosis in farmed cervids would require depopulation of all herds on the premises where the diagnosis was made, quarantine of the premises, and location/potential depopulation of any animals that had contact with the infected animal/premises in the past. Due to the small size of the game farming industry in B.C., and the decreasing number of farms in recent years, the loss of animals through depopulation is not likely to have a significant impact on the provincial economy. However, the consequences for individual producers who will suffer financially and emotionally from loss of animals, livelihood and land use, may be much more detrimental.

For more details on the potential effect of CWD on the B.C. public see Part VI below.

Part IV: Is B.C. currently free of CWD?

Surveillance for CWD in free-ranging cervids from B.C. began with samples collected in the fall of 2001; the samples were tested in 2002. Since then, over 800 samples were collected and submitted for CWD testing. In 2002, samples were submitted to the Alberta Provincial Agriculture Lab. In 2003 and 2004, most samples were submitted to the BCMAL Animal Health Centre (AHC) for testing. The AHC does not perform immuno-histochemistry (IHC) testing for CWD and so these samples were tested using a Prionics® Western Blot test (mentioned above). Since 2005, routine samples have been submitted to Prairie Diagnostic Services (Saskatoon, SK) and tested using IHC, and suspected clinical cases and moose samples have been submitted to the CFIA. All specimens submitted to date have been negative for CWD.

Obex, retro-pharyngeal lymph nodes (RPLN) and tonsils are the preferred CWD diagnostic samples. Early in the course of testing for this disease, the tissue of choice was obex. However for routine screening purposes now, tonsils and RPLN are collected. Tonsils are considered to be the best tissue for testing of deer because this tissue is the first to demonstrate PrP^{CWD} in the event of an infection, has the highest diagnostic yield (compared to RPLN), and is most resistant to post-mortem autolysis (Spraker et al. 2004, T. Bollinger per comm. 2008). In the event of a positive diagnosis, all three tissues are tested in order to confirm infection. In elk and moose (and other non-deer cervid species) all three tissues are used for screening since the distribution prion protein in subclinical infection these animals is much more variable (Spraker et al. 2004).

In B.C., wild cervids are tested for CWD by CFIA if they exhibit signs compatible with CWD. In the case of animals that do not show clinical symptoms, samples are submitted to one of three labs. The numbers of cervids sampled and tested by each lab to date are summarized in Table 4a. The number of wild cervids sampled and tested by species is provided in Table 4b.

Very few diagnostic tests are completely infallible in their ability to correctly identify animals as diseased or not diseased. In other words, some animals will be falsely classified as diseased when, in fact, they are healthy and vice versa. The chance of misclassification is dependent not only on the properties of the diagnostic test, but also on the stage of disease of the individual animal being tested, and the prevalence of disease in the population from which that animal originated. For example, PrP^{CWD} is more sparsely deposited in the tissues of subclinical animals compared to those showing clinical signs of CWD (Williams 2005). Consequently, animals in later stages of the disease may be more likely to test positive than sub-clinically infected animals because there is more infectious agent in their tissues.

Similarly, diagnostic tests tend to work better in populations with a higher prevalence of CWD (close to 50%) compared to populations with a low prevalence. If a test is applied to a population that has a low overall probability of infection (i.e. a population that is not known to be infected with the agent of concern), then a positive test result is most likely a false positive; the predictive value[6] of a positive test is low.

[6] The probability that an individual with a positive test result truly has the disease of concern (adapted from Last, 2001)

Therefore, in order to maximize our ability to detect CWD, we should focus surveillance activities on animals that have a higher probability of infection. This includes animals exhibiting clinical signs compatible with CWD infection and animals that are closest to known infected populations. However, the number of cervids in B.C. that meet these criteria is small. Cervids may not show detectable clinical signs of CWD for up to 36 months post infection (CFIA CWD MOP, 2002) and, at this time, CWD is not known to be present in wild populations that are close to the B.C. borders. This necessitates testing apparently healthy animals (mostly hunter-killed submissions) in order to permit the earliest possible detection of CWD entry into the province. However surveillance efforts should focus on areas where CWD is most likely to be introduced, and, if possible, on animals with signs consistent with CWD, in order to maximize the predictive value of CWD screening. Based on our current knowledge of CWD distribution in Canada and the US, this highest risk area of introduction into B.C. is along the border with Alberta.

Table 4a: CWD testing of wild cervids from B.C. by laboratory and year (data provided by the B.C. Ministry of Environment and the CFIA).

Year	Testing Lab							
	CFIA		Alberta Provincial Agriculture lab		AHC		PDS	
	# Samples submitted	# Samples tested[1]	# Samples submitted	# Samples tested	# Samples submitted	# Samples tested	# Samples submitted	# Samples tested
2002	0	-	209	175	0	-	0	-
2003	0	-	0	-	94	94	20	15
2004	0	-	0	-	55	55	10	10
2005	0	-	0	-	0	-	167	164
2006	37	37	0	-	0	-	187	180
2007	42	42	0	-	0	-	210	210
Total	79	79	209	175	149	149	594	579

[1] *Where the number of samples tested is less than the number submitted, the tissue samples received by the lab were not adequate for testing purposes.*

Table 4b: Number of free-ranging cervids by species tested annually for CWD since 2002 (Source – B.C. Ministry of Environment and CFIA, 2008) (in brackets is the number actually tested and for which there is a final test result)

Year	Total	Elk	White-tailed deer	Mule Deer	MD*WTD hybrids	Black-tailed deer	Moose	Caribou	Unknown Species
2002	209 (175)	32 (30)	71 (66)	103 (76)					3 (3)
2003	114 (109)	39 (35)	41 (40)	17 (17)					17 (17)
2004	65 (65)	5 (5)	1 (1)	3 (3)			1 (1)		55 (55)
2005	167 (164)	28 (26)	47 (47)	75 (74)	8 (8)		9 (9)		
2006	224 (217)	24 (21)	92 (92)	72 (70)	1 (1)	16 (14)	18 (18)	1 (1)	
2007	252 (251)	32 (32)	82 (82)	106 (105)		1 (1)	31 (31)		
Total	1031 (981)	160 (149)	334 (328)	376 (345)	9 (9)	17 (15)	59 (59)	1 (1)	75 (75)

In B.C., over 90% of all samples have been collected from the Kootenay (58%) and Peace (33%) Management Regions. Since it is possible for CWD-infected wild cervids to move from Alberta into B.C. in these border areas, the Kootenay and Peace Management Regions should be considered the most likely areas where CWD could be introduced into wild cervids. Therefore, these areas should continue to be where CWD surveillance in B.C. is focused.

In 2006, the level of wild cervid testing in B.C. was adequate to detect CWD at a prevalence of 2.1% (with 99% confidence) and 1.4% (with 95% confidence). Similarly in 2007, the level of testing in the province was adequate to detect CWD at 1.2% prevalence (with 95% confidence) and 1.9% (with 99% confidence). Based on the minimum population estimates for 2003 (see Table 2) the detectable prevalence by year for the province as well as the Peace and Kootenay Management Regions is shown (Table 5).

Table 5: The estimated detectable prevalence at 95% and 99% confidence by year[1] based on the number of samples submitted (number tested)

Year	British Columbia		Kootenay[2]		Peace	
	95% confidence	99% confidence	95% confidence	99% confidence	95% confidence	99% confidence
2002	1.5 (1.7)	2.2 (2.6)	2.7 (2.9)	4.1 (4.3)	6.2 (9.9)	9.4 (14.7)
2003	2.6 (2.8)	4.0 (4.2)	2.8 (2.9)	4.2 (4.4)	39.4	53.6
2004	4.6	6.9	-	-	4.6	6.9
2005	1.8 (1.9)	2.8	2.1	3.2	13.3 (14.0)	19.7 (20.6)
2006	1.4	2.1	2.5	3.8	4.5 (4.8)	6.8 (7.3)
2007	1.2	1.9	2.7	4.0	2.2	3.4

[1]*The prevalence estimates are based on a test with 100% sensitivity and specificity. Please note that the estimated test characteristics differ between years when different tests were used and would yield slightly different detectable prevalences.*
[2]*No samples were collected or tested from the Kootenay Management Region in 2004.*

There is no mandatory testing of captive cervids for CWD in B.C. To date, 27 captive cervids (16 reindeer and 11 elk) have been tested for CWD and all have been negative (M Wetzstein, H Schwantje and K Howden, pers., comm., 2008). Only one game farm is currently participating in a voluntary CWD control program. This is a reindeer farm is located in the Peace Management Region and was the likely source of all reindeer that have been tested (D. Sand, personal communication, 2008). B.C. does not permit game farming of elk but does permit a limited number of elk to be held under Wildlife Act permits in zoo and research facilities. All of the captive elk tested for CWD came from the Vancouver Zoo during a cull to reduce their herd numbers (H. Schwantje, personal communication, 2008).

Based only on the number of animals tested for CWD in B.C. and despite no positive test results, it is possible that the disease could be present in the B.C. cervid population at a low prevalence. However, CWD detection through laboratory testing is not the only method to ensure freedom from disease. The fact that most of B.C.'s neighbouring jurisdictions have not detected CWD in their cervid populations also supports the assumption that B.C. is currently CWD-free.

Only Alberta has detected CWD in wild cervids, and so far all cases have occurred in the south-east area of the province along the Saskatchewan border. Additionally, since 1996 Alberta had been conducting CWD surveillance on wild cervid populations through

government directed sampling and testing of hunter-killed animals. This program will hopefully allow Alberta to detect any westward spread of CWD cases in wild cervids in the province.

Both Alberta and Montana have detected CWD among captive cervids. However all CWD positive premises were a significant distance from the B.C. border (Figure 1) and no cases have occurred since 1999 (Montana) and 2002 (Alberta). Also, both Montana and Alberta have had mandatory CWD surveillance programs in captive cervids since 1999 and 2002, respectively, which allow for more comprehensive screening for the disease.

Appendix 1 (Tables 1 and 2) summarizes information about CWD programs in areas bordering B.C. for wild and captive cervids. ***Based on currently available information on surveillance efforts, and CWD-related regulations in neighbouring provinces, territories and states, it is unlikely that B.C. cervids have been infected with CWD at of the time of this assessment.***

Part V: What is the probability of CWD introduction into B.C.?

In North America it has been suggested that there are two concurrent CWD epidemics: one occurring in free-ranging cervids and the other in captive animals (Miller and Williams, 2004). As such, in the following sections of this risk assessment, information gathered on the captive and free-ranging cervid compartments will be treated separately.

This organizational structure of this report does not imply that captive and free-ranging cervid compartments are truly separate, as true compartmentalization of captive and wild populations is challenging and is affected by factors such as fencing design, management of intrusions and escapes, and carcass disposal on game farms. Regardless, in the following sections, wild and captive cervids will be treated as separate compartments except when is it pertinent to identify areas where the two are likely to interact.

Wild Cervids

What is the probability of CWD being introduced into wild cervids in B.C.?

Direct animal to animal contact and indirect contact through environmental contamination are considered to be effective means of CWD transmission (Miller and Williams, 2003; Miller and Williams, 2004). Transmission dynamics within and between populations may be further compounded by animal movement (Salman, 2003; Samuel et al., 2003). ***The risk of CWD infection in wild cervid populations in B.C. is therefore primarily associated with the natural movement of live CWD-positive animals from CWD endemic areas***. Other risks include human-aided movement of live, CWD positive cervids and transportation of dead CWD-positive animals or parts. However, because B.C. bans importation of cervids into the province (either wild or captive), this risk is substantially reduced. Although it has been suggested that CWD-infected carcasses can contaminate the environment and thus serve as a source of infection to live animals (Miller et al, 2004), only in New York was this the suspected route of introduction. In most jurisdictions, CWD is believed to have been the result of natural cervid movements or transportation of captive animals.

This risk is magnified by the fact that, despite implementation of surveillance programs in B.C. and other provinces/states, live, CWD-positive wild cervids are extremely difficult to identify; many CWD infected cervids remain subclinical for months or years. Because CWD confirmation requires post-mortem examination of the affected animal, movement of a live, confirmed CWD-positive case is unlikely. Animals tested by tonsillar or rectal biopsy are exceptions.

Wild cervids could enter B.C. from Yukon and Northwest Territories to the north, Alberta to the east, the states of Washington, Idaho and Montana to the south, and Alaska to the west (Figure 3). As mentioned previously, Alberta and Montana have confirmed cases of CWD. Montana has diagnosed CWD in captive cervids only, with 10 elk from a single

herd confirmed positive in 1999[7]. No additional positive cases have been found since despite ongoing surveillance efforts in wild and captive animals after depopulation of the positive herd. To date (March, 2008) Alberta has diagnosed 3 cases of CWD in captive cervids: one elk (March 2002) and two white-tailed deer on a single farm (November 2002). No further cases were found after herd depopulations and efforts to identify a source of the CWD infection in these herds were unsuccessful (neither farm could be linked to the concurrent outbreak among farmed cervids in Saskatchewan).

Figure 3: Map of the Province of British Columbia.
Source: http://www.britishcolumbia.com/Maps/?id=2

In addition to the CWD detected in farmed cervids, 52 cases of CWD in wild cervids have been confirmed in Alberta since 2005[8]. Between 1996 and 2007, Alberta tested 16,594 wild cervids in total[9]. All cases of CWD in wild cervids in Alberta have been found in the eastern part of the province bordering Saskatchewan (Saskatchewan has diagnosed CWD in at least 300 captive cervids on 53 farms (C. Argue, pers. comm.,

[7] http://www.cwd-info.org/index.php/fuseaction/policy.stateRegulations?state=MT: accessed January, 2008
[8] http://www.srd.gov.ab.ca/fishwildlife/livingwith/diseases/pdf/May_2008_positive_map.pdf: accessed June, 2008
[9] http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/cpv9448: accessed January, 2008

2008) and 195 wild cervids to date[10]. Alberta is the only CWD endemic jurisdiction bordering B.C., so wild cervids in Alberta present the most likely source for CWD introduction into wild cervids in B.C. However, it is important to recognize that the number of CWD-positive cervids in Alberta may be influenced by the situation in Saskatchewan as cervids move across the border. In addition, B.C. hunters travel to both provinces and thus should be made aware of the situation in these neighboring jurisdiction and the potential risk they pose to B.C.

The Canadian Rocky Mountains present a geographical barrier to cervid movement between B.C. and Alberta, particularly in the south of the province. Additionally, infected wild cervids in Alberta have all been found in the eastern part of the province, along the Saskatchewan border. This distance presents a considerable spatial barrier to movement of known infected cervids into B.C. Nevertheless, the balance of evidence and opinion suggests that proximity to a CWD-positive province or state is an important determinant of risk of CWD introduction (Gillette et al, 2003; Samuel et al, 2003). For this reason movement of live or dead cervids into B.C. remains a critical risk for CWD entry and presents unique challenges because it cannot be regulated in the same way as movement of captive cervids (Samuel et al, 2003). This is especially true in the northern part of the province where there is no geographical barrier to live wild cervid movement.

The risk of CWD spread is likely highest among animals showing clinical signs of disease because tissue infectivity tends to be higher at later stages of infection. As a result, clinical animals likely shed more of the infectious agent than subclinical animals, and thus are more likely to contaminate the environment and transmit the disease to other cervids. However, detection of symptomatic, wild cervids is limited both by limited human observation, and by the fact that wild cervids undergo natural seasonal fluctuations in body condition which may mimic signs of CWD (Miller and Williams, 2004).

Although we are considering captive and wild cervids in B.C. as separate compartments for most of this risk assessment, there may be more interaction between wild and captive cervids in Alberta. This is primarily due to the large number of cervid farms and wild cervids in the province and because native cervid species are farmed (including elk, white-tailed deer and mule deer, which are known to be susceptible to CWD). Furthermore, CWD has been diagnosed in both wild and farmed cervids in that province. It is important to consider this issue here, as the most likely way in which CWD will spread to wild cervids in B.C. is through movement of infected animals across the Alberta-B.C. border.

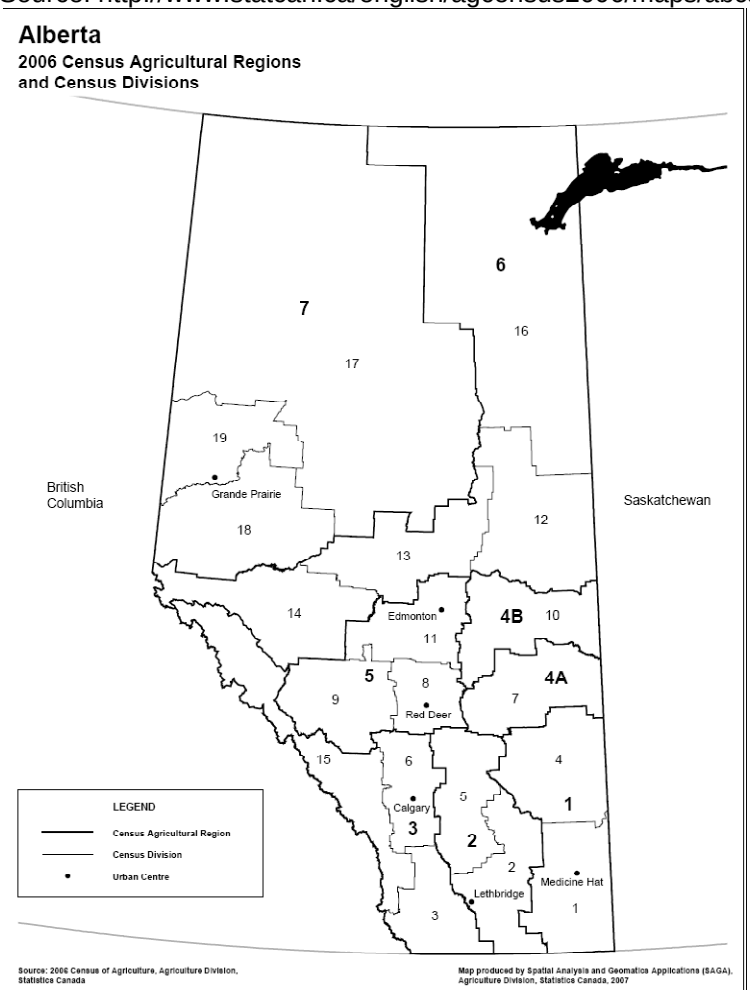
Alberta has five agricultural regions, two of which share significant borders with B.C. (Regions 3 and 7; Figure 4) (Alberta, 2006). There are 134 cervid farms within these two regions, containing a total of at least 12,572 captive deer and elk. In addition, region 5, which is in the central area of the province and extends westward near the B.C. border in the Kootenay area, contains 147 farms with 13,639 deer and elk.

Although all of the cases of CWD in wild cervids in Alberta have occurred in areas near the Alberta-Saskatchewan border (Figure 1), the presence of cervid farms across the whole province, including some on the B.C. border, creates a potential route for the

[10] http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1804,1800,95,88,Documents&MediaID=1003&Filename=Sk+cwd.pdf: accessed May, 2008.

disease to move west through movement of infected farmed cervids. The captive cervids could then serve as potential sources of CWD to more westerly wild populations. In other words if a CWD infected cervid is present in Western Alberta (Regions 3,5 or 7; Figure 4) it may be possible for the captive cervid to transmit the disease to local wild cervids. However, CWD transmission events between wild and captive cervids have thus far not been proven conclusively and, furthermore, in Alberta CWD cases in wild and captive cervid have not occurred in the same area or during the same time period. However, investigation and follow-up of the confirmed CWD cases on Alberta farms could not determine a likely source of infection; none of the test positive animals or farms could be linked to the ongoing outbreak among captive cervids in Saskatchewan. Because the source of infection remains undetermined, it is important that Alberta continue to survey wild and captive cervid populations across the province.

Figure 4: Map of the Alberta Agricultural Regions
Source: http://www.statcan.ca/english/agcensus2006/maps/abcar.pdf



There are three ways in which captive and wild cervids can come into contact (and thus potentially transmit CWD): a) through escape of captive cervids and b) through intrusion of wild cervids onto captive cervid premises and c) through fenceline contact.

Alberta has guidelines in place to minimize the incidence and impact of stray captive cervids. The Alberta Livestock Industry Diversification Act - Domestic Cervid Industry Directives and Procedures Manual outlines specific fencing standards, which are in place to minimize farmed cervid escapes (as well as wild cervid intrusions). These standards state that fences must be at least 2.5m high for elk and moose, and 2.8m high for deer. Specifications are also in place for fencing materials and construction. Refer to Appendix 1-Table 2 for an indication of how these standards compare to other jurisdictions.

The manual further states that in the event of an escape the owner of the escaped cervid must report to an appointed officer with Alberta Agriculture and Food within 48 hours of the escape (although immediate reporting is preferred). Alberta Agriculture and Food will then contact the Alberta Sustainable Resources Development who will issue a license to allow the use of traps, baiting etc. to recapture the stray cervid, although shooting the animal may be allowed in certain circumstances. An Alberta Sustainable Resources

Development officer will assist the producer with the formulation of a collection plan. Although it is expected that the cervid owner will make a "reasonable" effort to recapture the stray animal help will be provided upon request. Additionally, all farmed cervid require two tags, one in each ear (Domestic Cervid Industry Directives and Procedures Manual, 2007), which can aid in the identification of the escaped cervid.

Intrusion of wild cervids onto cervid farms is another way in which wild and captive cervids may come into contact and potentially transmit CWD, either through direct contact or via exposure of wild cervids to CWD contaminated premises. In Alberta, wild cervids are not permitted on cervid farms, and should an intrusion occur the producer must contact the ASRD who will issue a collection permit that gives the producer the authority to trap or shoot the cervid (Cervid Industry Directives and Procedures Manual). Further actions to be taken with the intruding cervid (i.e. CWD quarantine, etc.) are not specified in the manual.

The presence of fencing standards in Alberta, together with regulations for escapes and intrusions, likely result in a low frequency of these events. For this reason, the most likely route of contact between wild and captive cervids is through interactions across game farm fencelines. Wild cervids have been observed to frequent fencelines and research is currently underway in order to allow a better understanding of these types of contacts (Vercauten et al, 2005). One way to decrease fenceline contact and prevent disease transmission between wild and captive cervids is through the use of "double fences", i.e., two concentric fenclines with a space in between (Vercauten et al, 2005). At present, the use of double fencing is **not** mandatory in most provinces and states, including Alberta (Appendix 1-Table 2). Although some believe fenceline contact to be a means of transmission of CWD, thus far there have been no proven transmission events between farmed and wild cervids associated with contact along fencelines. Likewise it is still unclear what degree/type of fenceline contact would be necessary to allow this type of transmission to take place.

It should be noted that Alberta has also made substantial efforts to monitor for and prevent further CWD cases in captive cervids. Alberta has had a voluntary CWD program in place since 1996 and a mandatory CWD program has been in place since 2002 for captive cervids. As part of the mandatory program, the heads of all deer and elk over 1 year of age that die or are slaughtered must be submitted for CWD testing (the meat of slaughtered animals must be held until CWD tests results are generated). Additionally, the province has imposed import requirements in order to decrease the likelihood of new CWD introductions through movement of captive cervids. Exporting farms are classified as "high-", "medium-" or "low-risk" depending on their location, previous exposure to CWD infected animals and CWD monitoring/response standards, and this classification determines the Alberta import regulations/restrictions to be imposed (Government of Alberta, 2004).

Along with natural animal movements, CWD could be introduced into B.C. through anthropogenic translocations of wild animals, as well as movement of infected, wild cervid carcasses or parts. According to the CFIA's Interim Cervidae Movement Permit Policy[11] (2005) permits are required to move cervids from wild to wild settings in the provinces and territories of Saskatchewan, Alberta, Nunavut, Yukon, Northwest Territories and certain municipalities in Manitoba. Permits are also required for wild

[11] Accessed in Schwantje and Garde, 2007

cervid transport in any province if the capture or destination locations are within 100 km of a confirmed case of CWD. Permits are granted without restrictions in all other areas, or in any area provided the distance the animal is being moved is less than 20 km.

Under the B.C. Wildlife Act it is illegal to possess wildlife without a permit and the province generally does not permit any importation or direct translocation of wild cervids. Therefore, the probability of CWD introduction or spread through intentional, ***direct*** anthropogenic movement of wild cervids is low.

Translocation of wild animals in B.C. is possible in the context of wild cervid capture and release for rehabilitation and use in zoological and research facilities. Capture and subsequent release of wild animals is allowed under permit by the B.C. Ministry of Environment. Zoos and research facilities are required to attain a possession permit prior to operation and wildlife rehabilitation facilities are given a specific rehabilitation permit that covers possession. All facilities that wish to capture healthy animals from the wild in B.C. must also obtain a capture permit. Another permit is required to release wildlife back into the wild. Decisions to grant release permits are made by the B.C. Ministry of Environment on a case by case basis and vary according to the species involved and the region in question. The risk posed by CWD is one of the issues considered in this decision making process. Release of animals from rehabilitation facilities is allowed under the general rehabilitation permit but the facility must maintain detailed records for each animal (S. Black, personal communication, 2008). Movement of these animals is permitted under the aforementioned CFIA policy, and has similar regulations to those placed on direct movement of wild cervids (e.g. capture of a cervid within 100 km of a case of CWD is **not** permitted, and release generally must occur within 20 km of the site of capture). Unfortunately, the frequency and nature of these types of translocations are difficult to monitor. Although permits are granted by the B.C. Ministry of Environment, the records are not maintained in a central location but rather are kept at the local or regional level. For this reason, ***the probability of CWD introduction/spread in wild cervid populations through direct translocation of wild cervids is likely low, but difficult to accurately assess at this time.***

Under the B.C. Wildlife Act Permit Regulations (2000)[12], it is illegal for a regional manager to issue a permit allowing importation of cervids from outside of B.C. However, the Director of the Fish and Wildlife Branch – Ministry of Environment can issue a permit allowing the importation of cervids (and other banned species) when the applicant is an educational or scientific organization. No permits for cervid importation have recently been issued (S. Black, personal communication, 2008).

Movement of hunter-killed elk or deer carcasses from CWD positive areas into negative jurisdictions may be considered a risk for CWD introduction (Samuel et al, 2003). Evidence suggests that CWD-infected carcasses can contaminate the environment and thus serve as a source of infection to live animals (Miller et al, 2004). Though it is yet to be proven, this was the suspected route of introduction in New York (Major, 2005).

Because there is evidence to suggest that environmental contamination by dead animals or fluids could serve as a PrP^{CWD} source, B.C. has made the following recommendations to hunters when importing killed cervids from outside the province (Hunting and Trapping Regulations Synopsis, 2007-2008):

[12] http://www.qp.gov.bc.ca/statreg/reg/W/Wildlife/253_2000.htm: accessed May 2008

- Remove head, hide, hooves, mammary glands, all internal organs and spinal column at the kill site and leave these parts in the place of origin.
- Debone or have meat commercially prepared prior to removal from place of origin.
- Remove antlers and bone plate from the skull, removing all attached hide and soft tissue, and treat bone plate and antler bases with a solution of 2% chlorine.
- Raw capes and hides should be sealed in a waterproof container, frozen and delivered to a licensed tanning facility for processing as soon as possible.

At this point, these are recommendations and not regulations; however, as part of the B.C. Plan, the province has proposed to implement standards for preparation and importation of cervid carcasses and parts into B.C.

Products made from deer and elk parts or body fluids, including natural cervid attractants, may also have the potential to introduce CWD into a new area. However, introduction of the disease through this method has not been documented. Cervid scent can be used to attract cervids for hunting or viewing purposes and can be composed of cervid secretions such as urine, vaginal or scent gland secretions. B.C. does not currently regulate the use or importation of such products; however the 2007 – 2008 Hunting and Trapping Regulations Synopsis recommends that hunters use synthetic products instead. In the B.C. CWD Surveillance Response plan (Garde and Schwantje, 2007), a ban on the use of these products is advised.

Finally, some mention should be made about the potential relationship between wildlife feeding/baiting and disease transmission. Cervid feeding and baiting is undertaken for a number of reasons including attracting wildlife for hunting, preventing damage to agricultural crops, and providing food for wild cervid populations in times of harsh environmental conditions (Dunkley and Cattet 2003). Artificial feeding grounds have the potential to attract cervids of different species to the same area and to increase local population densities to a higher level than would be experienced in the wild. This could result in increased direct and indirect contact between and among cervid species thereby providing a greater opportunity for disease spread. There have been previous scenarios in the United States in which artificial feeding and baiting was thought to facilitate the spread of CWD in wild populations (Dunkley and Cattet 2003). Currently, the use of bait for hunting is not permitted in B.C., and although organized feeding of wildlife is not generally practiced in the province, there are no regulations against it (Dunkley and Cattet 2003).

Can B.C. detect CWD in wild cervids if it is introduced?

As described above in Part IV, B.C. has been carrying out surveillance of wild cervids for CWD since 2002. At the current (2006) level of surveillance (number of cervids tested), B.C. can detect CWD at a prevalence of 1.4% with 95% confidence. The number of animals tested in the Peace and Kootenay Management Regions in 2006 were adequate to detect CWD at a prevalence of 4.8% and 2.5% respectively (95% confidence). Refer to Table 5 on page 21 for more details.

Alberta is currently focusing their surveillance efforts in the eastern part of the province. All culling activities to date have occurred along the Alberta-Saskatchewan border and most hunter submissions have originated from the same area. There are 11 Alberta Wildlife Management Units where submission of hunter-killed cervid heads for CWD testing is mandatory (WMUs: 148, 150, 151, 162 (east), 163, 200, 234, 730, 236, 256,

500). There are an additional 9 WMUs where head submission is encouraged; these are adjacent to the mandatory submission areas (WMUs: 144, 152, 162 (west), 164, 202, 203, 232, 728, 238). Drop boxes are located throughout these areas as well as in Calgary and Edmonton. Surveillance of hunter-killed cervids for CWD is not as rigorous on the west side of Alberta. As a result, B.C. should continue to pay attention to the situation in Alberta and focus their attention and surveillance efforts in areas adjacent to the Alberta border.

What is the overall risk of CWD introduction into wild cervids in B.C. and what can be done to decrease this risk?

Based on currently available information, the most likely modes of CWD introduction into B.C. is through the natural incursion of CWD positive wild cervids from Alberta. At this time, CWD has only been detected among wild cervids in the eastern part of Alberta, away from the B.C. border. ***Therefore, the risk of CWD introduction at the time of writing (March 2008) is low.*** However, this risk level may change if the proportion of positive animals detected in Alberta changes or if CWD animals are detected further west, closer to the B.C. border. Similarly, the likelihood of CWD introduction into the province from other neighbouring jurisdictions will fluctuate with the presence or absence of CWD in these other states and provinces. We are not aware that any jurisdiction has completely eradicated CWD once it has been detected. In Montana, no positive animals have been detected since 1999 but uncertainty remains about the length of time the prion is viable in the environment. Furthermore, our ability to detect disease at a low prevalence in large, free-ranging wild populations is limited. Because of these challenges, it is our opinion that the most effective way of managing CWD in B.C. is to prevent its introduction into the province.

At this time the most likely place that CWD will be introduced into the province is from Alberta into north-eastern B.C., because in this region there are no geographical barriers separating the 2 provinces. In 2006, the number of animals sampled and tested in B.C. that come from the Peace region is adequate to detect CWD below a prevalence of 4.5% (at 95% confidence) or 6.8% (at 99% confidence). Therefore surveillance efforts should be enhanced in the north-eastern part of the province. This can be accomplished through enhanced testing of animals exhibiting clinical symptoms compatible with CWD, including additional testing of road kill animals, and increasing the number of hunter-killed submissions. In 2007, the number of cervids tested from the Peace region more than doubled over 2006 numbers thereby reducing the detectable prevalence to 2.2% (at 95% confidence) and 3.4% (at 99% confidence).

Additionally, education of hunters returning to B.C. from Alberta and Saskatchewan should be continued and expanded. For example, the recommendations for cervid carcass handling and use of cervid products (currently available in the 2007-2008 B.C. Hunting and Trapping Regulations Synopsis, and on the B.C. Ministry of Environment website, Schwantje 2006) should be more easily available and more widely publicized to those hunting in B.C., and to B.C. residents hunting outside the province. Hunter education about CWD, particularly in the Peace Management Region presents another means of increasing the number of animals tested. As hunters who understand the disease may be more likely to submit heads from animals they kill.

It is our recommendation that B.C. enhance its surveillance efforts, particularly in the Peace Management Region. This is the area considered to be most at risk and thus

where the greatest effort should be placed on surveillance. In order to detect a low prevalence of disease (<=1%), at least 299 cervids would have to be sampled and tested annually in this Management Region. This number would have to be increased to 459 to achieve 99% confidence (assuming the test used is 100% sensitive and specific).

Captive Cervids

What is the probability of CWD being introduced into captive cervids in B.C.?

Only fallow deer and reindeer are farmed in B.C. and, to date, CWD has not been diagnosed in either species. Game farms in B.C. are provincially regulated by the Ministry of Agriculture and Lands (BCMAL), under the *Game Farm Act*. Producers are required to comply with regulations for domestic farm animals, including those in the *Livestock Act*, the *Animal Disease Control Act*, the *Waste Management Act*, and the *Meat Inspection Act* (Garde and Schwantje, 2007). Legislation is administered “to minimize the risks of disease transfer to wildlife and domestic livestock, to minimize genetic contamination and illegal trade of wildlife, and to foster the industry's development.” (B.C. Ministry of Agriculture Food and Fisheries, 2004). All producers require a Game Farm License and must meet standards identified in the *B.C. Game Farm Manual* (Government of B.C., MAL, 1992). These include requirements for fencing and animal handling facilities; animal registration and identification, record-keeping and reporting; recapture and reporting procedures for game at large; humane practice of various animal handling and husbandry procedures; and animal movement, transportation and slaughter. B.C. Game Farm Manual has not been updated since 1992.

In order to obtain a game farm license, an application must be submitted including applicant and farm information and a development plan detailing the proposed facilities, species of animal to be farmed, proposed herd size, fencing type and manufacturer, and breeding stock supplier information. Provisional approval of the application allows the applicant to proceed with construction of the facilities. A site inspection is then conducted before final approval allowing the possession of game farm animals.

Game farm animals being imported to B.C. from any location require a provincial Import Permit and a veterinarian certified Health Certificate. Imported animals must also be certified free of brucellosis, tuberculosis, Johne’s disease, anaplasmosis and bluetongue, and they must be held in on-farm quarantine for a minimum of 60 days and be examined by a licensed B.C. veterinarian at the end of the quarantine period. Any animal that dies during the quarantine period must be necropsied and reported to the provincial Chief Veterinary Officer. Additionally, all cervid movements between provinces require a Cervid Movement Permit authorized by the CFIA. At present there are no CWD conditions associated with the permit, however movement would not be authorized if the herd or animals in question were under quarantine for CWD (K. Howden personal communication, 2008).

Cervids imported to BC from outside of Canada require a Federal Import Permit from the CFIA, (British Columbia Game Farm Procedures Manual, 1991) and, for movement from captive to captive setting, all cervids must be identified with a unique-to-the-animal identification device to allow tracing. Specific CWD requirements are that the herd of origin must not be quarantined or under investigation by the CFIA for CWD, and must not “accept wild-born cervidae, or their carcasses or parts, onto the premises for

slaughter, processing or taxidermy." (British Columbia Game Farm Procedures Manual, 1991) The above criteria do not need to be satisfied to obtain a permit for an animal being transported directly to slaughter at a federally or provincially inspected abattoir.

Furthermore, within Canada, in an attempt minimize the spread of CWD, if a CWD positive captive cervid is detected, the premises (premises is singular) on which that animal resided is declared an infected place, and all other cervids on that premises are depopulated and tested. Trace outs are conducted in order to locate all animals that had resided on the infected place in the 60 months prior to CWD detection. Animals that left the premises within 36 months are depopulated and tested, whereas animals that left between 36 and 60 months are put under a 60 month enhanced surveillance program involving movement restrictions and quarterly clinical evaluations. (CFIA CWD MOP 2002, K.Howden per comm).

Although only fallow deer and reindeer are farmed in BC, the BC farmed cervid industry does have regulations in place to minimize contact between wild and captive animals. These regulations include specific fencing requirements to prevent escape of captive cervids, or intrusion of wild cervids onto domestic cervid premises. In the BC Game Farm Procedures Manual (1991) fencing standards specify minimum height (2.1m), as well as materials and construction. These standards are similar to those in neighboring jurisdictions, except with respect to height requirements. Although fencing height standards are slightly shorter in BC than in neighboring provinces/states (Appendix-1, Table 2), this may be due to the species of cervids farmed (i.e. elk and deer in other areas compared to fallow deer and reindeer in B.C.). In fact, Ontario recommends a fence height of only 1.9m for fallow deer, and Michigan recommends a fence height of 1.3m for reindeer.

The game farming industry in BC is small and limited to non-native species in which CWD has not yet been detected. Currently, few animals are imported into the province (D. Sand, pers. comm., 2008). The small scale of the industry and limited animal importation and movement reduce the risk of CWD introduction into farmed cervids in the province.

Although native cervids cannot be farmed under current BC regulations, elk and other native cervid species can be held in captivity for public display in a zoo or wildlife park. Zoo permits are granted by the Ministry of Environment for herds of up to 20 adult animals (over 18 months of age). There is no central registry of these operations; permits are kept regionally. There are few cervids held in captivity in zoos, wildlife parks or research facilities in BC. The total number however is unavailable and despite our efforts could not be confirmed.

The CFIA's Interim Cervidae Movement Permit Policy (2005) regulates movement of wild-born cervids into and out of captive facilities. All facilities designated to receive and possess wild cervids (wildlife rehabilitation facilities and zoos) must have permits to hold the cervids from BC Ministry of Environment and be identified by the BC Ministry of Environment to the CFIA, which will then issue a blanket annual permit to each facility. As mentioned above (Part V), this permit stipulates that wild cervids must not originate from a MU located within 100 km of a confirmed case of CWD. Details of each individual animal movement must be recorded and submitted to the CFIA.

Can B.C. detect CWD in captive cervids if it is introduced?

Because of the small size of the industry, very little if any testing of captive cervids for the presence of CWD has been done in BC, and only 1 farm in BC is participating in the CFIA volunteer herd certification program. Since 2002, only 27 captive cervids in BC have been tested for CWD. These include 11 captive zoo elk and 16 reindeer. All captive cervids tested have been negative and all testing has been done by the CFIA (Table 4.a, page 19). There are no requirements for CWD testing in zoo or research animals.

What is the overall risk of CWD introduction into captive cervids in B.C. and what can be done to decrease this risk?

At this time, ***the probability of CWD introduction into farmed cervids in BC is low.*** This is due to a combination of factors including the small size of the industry, limited cervid imports, and the fact that CWD has not yet been diagnosed in fallow deer and reindeer (the cervid species farmed in BC). In order to keep this risk level to a minimum BC should continue to maintain its current restrictions on cervid farming and importation.

The risk of CWD in farmed cervids in BC, however, may change in the event that CWD is diagnosed in reindeer, fallow deer, and/or wild cervids in BC (especially if it becomes apparent that wild and captive cervid compartments are not completely separate in the province). This may necessitate an increase in the level of surveillance in farmed cervids, and/or the creation of a mandatory CWD surveillance program similar to those that are currently present in Alberta and Saskatchewan.

There are few native cervid species permitted to zoos or wildlife parks in BC. As such, as of February 2008 the likelihood of CWD introduction into this compartment is low. However, centralised record keeping of the number of herds, herd location, number of animals per herd and any animal movements or releases would facilitate management and traceback should CWD (or another disease) be detected. Additionally centralized regulation of captive wild cervids would allow creation and enforcement of standards for housing, fencing, capture, movement, release etc., all of which can play role in disease prevention. Despite our efforts, at the time of writing current regulations for captive wild cervids in BC could not be confirmed.

Finally, as mentioned above, in the event that CWD is diagnosed in wild cervids in B.C., regulations regarding capture and release of wild cervids may require alteration.

Part VI: What are the consequences should CWD be introduced in BC?

What are the consequences should CWD be introduced into wild cervids in B.C.?

Consequences for wild cervid populations and the ecosystem

Very little is known about the long term affects of CWD on cervid populations and the ecosystems in which they exist (Gross and Miller, 2001). Because of the paucity of observational research into the ecological effects of CWD, most of the information on this subject is gained from population modeling. In the model created by Gross and Miller (2001), CWD infection was predicted to have dramatic negative effects on cervid populations. The authors predicted a dramatic increase in CWD prevalence, with in an equally dramatic decrease in population size after the introduction of CWD into a group of animals. In fact, most models of CWD infection resulted in eventual extinction of the infected populations (Gross, 2001). More recently, however, these models have come come under criticism (Schauber and Woolf, 2003). The authors believe that further research into the subject may reveal that deer populations may be able to develop a stable co-existance with CWD without dramatic decreases in population size (Schauber and Woolf, 2003). Thus far there has been no further published research to favor one or the other theory, therefore the true ecological impact of CWD remains unknown. It is important to note, however, that, up to this point in time, we are not aware of any extensive cervid population declines resulting from natural CWD in wild populations.

An additional consideration for the risk of CWD transmission into wild cervid populations in BC is the potential ecological impact of management tools, especially depopulation of infected herds (should this become a component of BC's CWD management program). The impact of removing large numbers of cervids from an ecosystem has yet to be determined. However one could speculate that it could result in the incursion of other cervid populations or subpopulations into the contaminated, vacant habitat, thus increasing the number of animals that could potentially come into contact with CWD and become infected. Depopulation of infected cervids or herds could also impact the predator community that relies on the herds as a food source, other animal species that use similar habitats, and the plant community in the affected area. At this time the effects of wild cervid depopulations are not known.

Consequences for humans

Economic consequences:

As described earlier (pages 17-19), hunting and other outdoor and nature-related activities are important to British Columbians and to the provincial economy. How the BC public will respond to detection of CWD is uncertain. However, lessons can be learned from other jurisdictions where CWD has already occurred. In the State of Wisconsin, the number of hunting licenses sold dropped by 12% in the year CWD was detected (2002). Bishop (2002) estimated that Wisconsin hunters would lose $70-$100 million in recreational activity benefit due to CWD. However, the author notes that only $5-10 million would be lost directly to the economy. The other component would reflect non-market losses and this would be borne primarily by hunters (Bishop 2002). He argues that the Wisconsin economy would likely not suffer tremendous losses because, as is

the case in BC, most hunters are local and thus if they choose not to hunt are still likely to spend their dollars in state.

In 2004, the Ontario Ministry of Natural Resources (OMNR) commissioned a report of the potential economic impacts of CWD infection in wild and/or captive cervids to the province's economy (Lazo et al, 2004). The authors concluded that if CWD was detected in Ontario, those working directly with the captive cervid industry would suffer direct economic losses (loss of jobs and reductions in salaries) and this would cause a ripple effect across the whole province. Five scenarios were assessed (including both severe and milder impacts). The authors predicted that a 25% reduction in hunting by aboriginal people would cost the Ontario economy approximately $1.5 million; decreased hunting license renewals would cost the provincial economy $260,000-1,330,000; compensation to farmers and control measures would potentially cost millions of dollars, depending on the scale of the response.

In both the Wisconsin and Canadian papers, during the attempt to describe the value of wildlife and nature, it became apparent that the most significant value placed on wildlife is not in relation to direct economic benefits but rather to intangible impacts: maintenance of biodiversity, nature viewing activities, the value perceived by knowing that the resource is there, etc. In 2002, Chardonnet et al (2002) summarized the value of wildlife globally. In the manuscript they divided the value of wildlife into 4 headings: the economic importance, nutritional value, ecological roles and socio-cultural significance. In the developing world, the socio-cultural importance of wildlife included wildlife viewing as a positive and predation (on crops and livestock), disease maintenance and introduction, and vehicle collisions as negatives. Similar information is captured in Edwards and Abivardi (1998). In both papers, the non-consumptive value of wildlife far exceeds the consumptive value.

Cultural significance:

First Nations people in British Columbia are not required to obtain hunting licenses, and may harvest wildlife for sustenance purposes (food, social and ceremonial purposes) in traditional areas. First Nations individuals are, however, required to comply with hunting regulations pertaining to public health and public safety (Government of BC, MOE, 2007c). Additionally, access to and use of wildlife has cultural importance to First Nations people and rural communities in BC. What the impact of CWD would be on the culture value ascribed to cervids in the province remains uncertain.

Human health:

Based on currently available information, CWD cannot be transmitted from cervids to humans. There has been no documentation of humans contracting prion disease from cervids, either through consumption of infected carcasses or by direct contact with live, infected animals. A study in Wisconsin investigated 3 cases of degenerative neurologic disease in hunters and found no association between CWD and CJD (MMWR 2003). Regardless, prudent use recommendations suggest that, as a precautionary measure, meat from infected animals should not be consumed.

What are the consequences should CWD be introduced into captive cervids in B.C.?

If CWD is detected in captive cervids in BC then the CFIA would follow the same protocol as is illustrated above (under What is the probability of CWD being introduced into farmed cervids in B.C.?), namely depopulation of the infected herd, with location and quarantine/depopulation of any potential source herds, and any animals that had left the affected herd before the time of CWD diagnosis (CFIA CWD MOP and K. Howden per comm.). Additionally, products (i.e. meat, antler velvet) harvested from any animal diagnosed as being CWD positive would be destroyed (CFIA CWD MOP 2002). Therefore, if CWD was detected in a farmed cervid in B.C., the loss of animals and associated products would have an economic impact on the owners of the CWD premises. However, because the industry is small and is decreasing in size, and because of the limited economic value of individual animals (approximately $200-300 per animal, N. Dewith per comm., 2008), the consequences of detecting CWD in farmed cervids would likely be limited at the provincial level. The BC cervid industry as a whole can be estimated to be worth approximately $1 million; however accurate assessments are difficult to obtain (N. Dewith, pers comm., 2008).

For owners of farms where CWD has been detected, additional consequences stem from loss of land use. If CWD is detected in a preclinical animal that can be epidemiologically linked to a separate CWD-positive location, then the premise is subject to a one month fallow period following depopulation with lifting of the quarantine subject to adequate decontamination (CFIA CWD MOP 2002, K. Howden pers., comm., 2008). However, if the CWD-positive animal is clinical or cannot be epidemiologically linked to another CWD infected place, then the premise is subject to a minimum one year fallow period, with further extension of the quarantine being established on a case by case basis. Similarly, quarantine can only be lifted following adequate decontamination of the premises (CFIA CWD MOP 2002, K. Howden pers., comm., 2008). In the CFIA CWD response plan, producers are compensated for the value animals lost through slaughter of infected or suspect animals; there is no compensation for loss of land use due to quarantine procedures.

Should CWD be confirmed in a captive animal held at a zoo or wildlife park, the same protocol would be followed as when a farmed cervid tests positive; the herd would be depopulated and tested for CWD as per the aforementioned CFIA CWD management regulations. Zoos and wildlife parks present a small industry in BC, and cervid herds probably represent only part of their total collection. For this reason, the negative economic impacts of CWD introduction on these facilities and on the provincial economy is likely to be limited.

Finally, should a subclinical (and thus unidentified) CWD-infected animal from a zoo, research or rehabilitation facility be released, there is potential for spread of CWD into wild cervid populations in B.C. Although this scenario is purely speculative at this time, it is not possible to completely discount the possibility of a wild, subclinically-infected animal being captured, transferred to a facility and transmitting the disease to other cervids in the captive facility with subsequent release of newly-infected cervids into the wild. Unfortunately, since we were unable to confirm specific zoo, research and rehabilitation regulations at the time of writing we are unable to further expand on the likelihood of the aforementioned scenario.

Part VII: Is BC's current CWD management plan sufficient to adequately detect and handle CWD infections in captive and/or wild cervids in the province?

Owing to the risk of CWD spread to BC a CWD surveillance plan has been suggested. The proposed *Surveillance and Response Plan for Chronic Wasting Disease in British Columbia* (Garde and Schwantje, 2007) is focused primarily on preventing the entry of CWD into BC. As part of this plan, two regional working groups have been created for the Peace and Kootenay Management Regions, which are considered to be at increased risk due to their locations along the Alberta border. These working groups will provide information, "identify and discuss local concerns and needs with regard to CWD," and "discuss practical methods of implementation of actions at the local level" (Garde and Schwantje). The BC Plan also proposes to create statistically meaningful surveillance goals, especially for these higher risk areas, and implement information-sharing and collaboration activities with neighbouring jurisdictions.

At this time, the plan outlined in BC's CWD surveillance and response plan describes response scenarios in the case CWD is detected in both wild and captive animals. Briefly, should a case of CWD be confirmed in a wild cervid, the BC Ministry of Environment Wildlife Veterinarian will supervise and coordinate any epidemiological investigations or response actions, whereas in the event that CWD is diagnosed in a captive cervid (both farmed and zoo/research/rehabilitation animals), the CFIA and members of the BC CWD Technical Group would lead further investigations, depopulations and quarantines. Further details of the proposed CWD response plan for BC are outlined below.

CWD Response in Wild Cervids

In the event that CWD is detected in a wild cervid by a provincial laboratory, the sample will be forwarded to the national lab to confirm the result. Because CWD is a notifiable disease, the CFIA district veterinarian and the provincial wildlife veterinarian will be notified. Confirmation of CWD in the province will be communicated to the Chief Veterinary Officer who will also contact the provincial wildlife veterinarian. The provincial wildlife veterinarian will take the lead for outbreak management, and will inform the provincial ministries of agriculture and environment, CFIA and the regional BC CWD technical and working groups. The BC CWD Technical Group is chaired by the BC Wildlife Veterinarian (Ministry of Environment), and consists of the following:

- Manager, Wildlife Science Section, Ministry of Environment
- Chief Veterinarian, Ministry of Agriculture and Lands
- Wildlife Veterinarian, Parks Canada
- Wildlife Conflicts Prevention Coordinator, Ministry of Environment
- Recreation District Officer (Chilliwack), Ministry of Tourism, Sport and the Arts
- Biologist, Guide Outfitters Association of BC
- Provincial Ungulate Biologist, Wildlife Science Section, Ministry of Environment
- District Veterinarian, Canadian Food Inspection Agency
- Parks and Protected Areas Program Specialist, Ministry of Environment
- Director, Lands and Resources Department, Fort Nelson First Nation (FNFN)
- Game-Farming Chairman, BC Wildlife Federation

The role of this working group is to create/modify CWD management plans for the province, as well as to develop and identify funds to carry out the plan if necessary. In the event that CWD is diagnosed in a wild cervid in the province this group will identify specific government/jurisdiction/agency roles for CWD response, and will aid in coordination of disease management efforts.

Two regional working groups have also been formed for the highest risk regions of the province: Peace and Kootenay Management Regions. As mentioned previously these areas share a boarder Alberta, and thus are the most likely regions to experience incursion of CWD infected wild cervids. Both regional working groups are chaired by the Provincial Wildlife Veterinarian, Ministry of Environment.

The Peace Region Working Group consists of representatives from the following groups:

- Wildlife and Ecosystem Sections, Ministry of Environment
- Conservation Officer Service, Ministry of Environment
- Peace River Regional District
- Prairie Farm Rehabilitation Administration
- Dawson Creek Rod and Gun Club
- North Peace Rod and Gun Club
- Guide Outfitters Association of BC
- Rocky Mountain Taxidermy
- Treaty 8 Tribal Association
- Fort Nelson First Nation
- Ministry of Agriculture and Lands

The East Kootenay Region Working Group consists of representatives of the following groups:

- Wildlife and Ecosystem Sections, Ministry of Environment
- Conservation Officer Service, Ministry of Environment
- Kootenay Livestock Association
- BC Wildlife Federation
- East Kootenay Wildlife Association
- BC Conservation Corps
- Fernie Rod and Gun Club
- BC Ministry of Agriculture and Lands

The goal of these groups in event of CWD diagnosis in their respective regions is to identify the most practical methods of managing the disease at a local level.
The intent is that if CWD is detected in the province, the BC CWD Technical Group and the regional working group where the disease is confirmed will work together to control the outbreak. The plan for outbreak management at this time is non-specific and will be adapted to the species, location and severity of the outbreak.

It should be noted there are currently no regional working groups for areas of the province other then the Peace and East Kootenay Regions, and it is not clear how a CWD response would be coordinated in those regions without a working group. In the future it may be beneficial to assemble basic working groups for all regions in BC, especially in event that CWD is diagnosed in a neighboring jurisdiction other then Alberta (e.g. Yukon or Washington).

Within the draft response plan, the following action items are listed:

1) If the positive animal was hunter-killed, the Ministry of Environment Wildlife Veterinarian will initiate epidemiological investigations to trace back the source of the CWD positive animal and contact the hunter to determine if the meat entered the food chain.
2) The Wildlife Veterinarian will implement a targeted reduction of free-ranging cervids and begin efforts to determine the potential spatial distribution and prevalence of CWD in the outbreak area. The Wildlife Veterinarian will also assess the risk of CWD spread to free-ranging cervids in adjacent areas, and implement appropriate surveillance measures. Finally, the Wildlife Veterinarian will restrict movements of hunter-harvested cervids and cervid parts in the target area.
3) All culled animals will be submitted for CWD testing.
4) The Ministry of Environment Wildlife Veterinarian will coordinate public communications and develop pre-approved cooperative press releases.
5) CFIA will lead efforts to determine the prevalence and risk to captive cervids in the area of the positive diagnosis.

It is unlikely that the positive animal will be traced back to the hunter (incomplete information is often provided with hunter-killed animals and the time lag between when the animal is hunted and when the sample is tested can be up to 8 months) (H. Schwantje, pers. comm.., 2008).

As mentioned in the response plan, the wildlife veterinarian will develop and implement a targeted reduction strategy for free-ranging cervids (with input from the CWD Technical group and regional working groups in the Peace and East Kootenay regions), and all culled animals will be tested for CWD in attempt to determine the geographical extent of the disease incursion. The scope of the reduction strategy will be determined at the time of the outbreak, however ***in order to facilitate and speed response, the working groups should develop scenarios and pre-assign tasks ahead of time***. For example, should a single CWD positive elk be detected in the Peace Region, a tentative plan could include the range of culling, number of animals to be tested, of what species, disposal, etc. Preparing this information in advance would help to save time in the event of an outbreak, and documentation of the tasks assigned to each member of the technical and working groups would facilitate organization of disease response should CWD be detected. Contact names and numbers for the technical and working groups should be kept current and easily accessible.

Because CWD is not an acute disease, immediate response is not critical to outbreak control. In other words, once the disease is detected, it is likely that the animal has been carrying the prion for months or years and other animals have long since been exposed/infected. As a result, there is time to prepare a response tailored specifically to the area and species involved. However, ***pre-established scenarios and pre-assigned tasks would facilitate discussions and implementation of plans without constraining the nature and scale of the response.***

Funding for culling and increased testing of cervids would be accessed through the BC Ministry of Environment executive on an emergency basis. The ability to carry out additional testing would also depend on laboratory capacity at the provincial and federal levels. It is possible that other laboratories would be asked to assist in processing the additional cases (H Schwantje, pers. comm., 2007).

CWD Response in Captive Cervids

If CWD is detected first in a captive cervid (including farmed and zoo/rehabilitation animals) then the CFIA will lead further disease management efforts. For more information about the CFIA's general disease response procedures please refer to the CFIA Common Procedures Manual[13], which will serve as the reference document guiding investigation and response. The BC Ministry of Environment will determine the risk of spread to surrounding wild cervid populations, and will implement surveillance and management procedures for these populations. This will work in a similar manner to what is described above (CWD Response in Wild Cervids) and our recommendations are the same: consideration of different scenarios ahead of time, pre-assigned tasks and responsibilities for working and technical group members, up to date and accessible contact list.

[13] www.inspection.gc.ca/english/anima/heasan/disemala/cpm-mpc/indexe.shtml

Part VIII: Summary of risk and recommendations to mitigate risk

Risk	Recommendations
CWD detection ability among populations of free ranging cervids.	Focus surveillance efforts along BC-Alberta border, particularly in the Peace Region to improve detection ability.
	Develop and maintain a process for open and frequent communication about CWD with all neighbouring jurisdictions. This will allow BC to adapt its CWD surveillance and response plan in relation to changing CWD prevalence in surrounding areas to maximize disease detection ability (note that this applies equally to CWD infection in wild and captive cervids).
	Evaluate detection plans annually in light of how the risk status of neighbouring jurisdictions changes.
Introduction of CWD into BC through movement of CWD infected wild cervids and parts.	Continue and increase hunter education/awareness about risks associated with movement of carcasses/carcass parts.
CWD detection ability among captive cervid populations	Improve understanding of where all captive cervids are located – including zoo and research animals.
Introduction and spread of CWD through movement of farmed cervids.	Maintain current strict import and export regulations and game farming protocols.
Ability of BC to initiate a timely response should CWD be detected in wild or captive cervids in the province.	Formalize communication, update contact information and develop roles and responsibilities for the various parties potentially involved in CWD response before the disease is detected.

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Appendix 1: CWD Regulations in Neighbouring Jurisdictions

***Table 1: Wild Cervids** (Information compiled from state and provincial governments and personal communications)*

		British Columbia	Washington	Idaho	Montana	Alberta	Northwest Territories	Yukon	Alaska
Cervid populations	Total (minimum)	470500	376000	600000	710000	564000	1570000	218600	1199865
	Cervid Species included in population estimate	White-tailed deer, mule deer, elk, moose, caribou	White-tailed deer, mule deer, elk, moose, feral sitka deer	White-tailed deer, mule deer, elk, moose.	White-tailed deer, mule deer, elk, moose.	White-tailed deer, mule deer, elk, moose	Moose, caribou	Mule deer, elk, moose, caribou	Sitka deer, black-tailed deer, elk moose, caribou, reindeer
Surveillance efforts	Number cervids tested for CWD	649	4722	>5100 (19997-2006)	3800	5868 (2002-2005); >8000 since 1996	100 (all caribou)	19	1959
	Number of CWD positive animals detected	0	0	0	0	30	0	0	0
	Source of test animals: Hunter harvest Road kill Other		Hunter harvest, Road kill, Symptomatic animals	Hunter harvest, Road kill, Targeted sampling of clinical animals.	Hunter harvest, Road kill, Symptomatic animals	Hunter harvest, Government sampling	100% Government cull (all caribou)	Road kill	Hunter harvest, Road kill, Found dead, Symptomatic animals
	Year surveillance commenced	2002	1996	1997	1998	1996	2006		2003
	Test used	IHC	IHC	IHC	ELISA	BioRad ELISA	BioRad ELISA	BioRad ELISA	IHC
Regulations and guidelines	Carcass preparation and movement	Recommendations but no regulations for carcass preparation, movement and	Restricted import of cervid parts from CWD positive	None	Restrictions on imports from states and provinces	None	None	None	Importation of whole carcasses and certain carcass

		import.	states and provinces		with CWD in wild or farmed populations				parts banned from CWD susceptible animals
	Feeding and baiting		Discouraged	Baiting is not allowed; Feeding restrictions in brucellosis areas	Not allowed	No baiting allowed, no feeding ban	No ban	No ban	No baiting or baiting allowed
	Rehabilitation	No capture of cervids from a MU within 100km of a confirmed CWD case. Captured cervids can only be released from within 20km of the capture location.	None		No private rehabilitation centers. One government regulated moose rehabilitation center (animals returned to site of origin or euthanized)	Cervids for rehabilitation cannot be moved into or out of a designated CWD risk area	None	None	No release of captive moose, Permanently captive animals all checked for CWD post mortem.

***Table 2: Captive Cervids** (Information compiled from state and provincial governments and personal communications)*

		British Columbia	Washington	Idaho	Montana	Alberta	Northwest Territories	Yukon	Alaska
Cervid populations	Number of animals	3848	Not known, probably <200	7000	2000	36286	0 No captive facilities allowed	57	623
	Number of farms	31	Not known, probably <20	78	51	467	0	4	16 (plus 25 Reindeer herds)
	Species farmed	Fallow deer; Reindeer	Fallow deer, Reindeer, 2 Elk farms (one illegal)	Elk, Fallow deer, Reindeer	Mostly elk, few white-tailed deer and mule deer.	Elk; White-tailed deer; Mule deer	n/a	Elk	Elk, Reindeer
Surveillance efforts	Number cervids tested for CWD (2004-2006)	0	20	3000	3700	24236	n/a	64	35 cervids on farms, 55 reindeer from non-fenced herds
	Number of CWD positive animals detected	0	0	0	10 (1 herd in 1999)	0 (2 WTD and 1 elk tested positive for CWD in 2002)	n/a	0	0
	Source of test animals: Clinical Aclinical	n/a	>95% clinical <5% aclinical	99% aclinical	Mostly aclinical.	Unknown, presumed mostly aclinical (clinical animals must be specially reported)	n/a	Not available	All aclinical
	Test used	IHC	IHC	IHC	ELISA	BioRad		BioRad	IHC

						ELISA		ELISA	
Regulations and guidelines	Movement of animals	Within Canada: No movement of animals from a CWD quarantined herd. Import from other countries: No import from herds under CWD suspicion or quarantine, or from herds that accept wild cervids, carcasses, or parts.	None	No mule deer or white-tailed deer imports; elk must be from herd free from CWD monitoring program of at least 5 years and with a free status; Imports banned from CWD endemic areas;	None from CWD endemic areas; cervids must originate from herds participating in a CWD monitoring program for at least 5 years	No import from areas without CWD surveillance or response protocols. Import with specific requirements permitted from endemic and non-endemic areas with surveillance and response protocols.	n/a	Movement regulations according to CWD surveillance and certification program, game farm regulations and CFIA transport regulations.	Importation of cervids only from CWD-negative certified herds
	Fencing	Regulations on height (at least 7' high) and construction	Yes	8' wire-net fencing	Decided by Dept. of Fish, Wildlife and Parks on a case-by-case basis.	Regulations on height (8-9' depending on species) and construction.	n/a	None	Regulations on height (at least 8' high) and construction.
	Mandatory CWD program	No	No	Yes	Since 1999	Since 2002	n/a	Yes	No
	Voluntary CWD program	Yes	No	No	No	From 1996-2002	n/a	Yes	Yes

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