CASE STUDY 3

Two managed diseases: Bovine tuberculosis and brucellosis. The following excerpted from Leighton, F.A. 2011. Wildlife pathogens and diseases in Canada. Canadian Biodiversity: Ecosystem Status and Trends 2010, Technical Thematic Report No. 7. Canadian Councils of Resource Ministers. Ottawa, ON. iv + 53 p. http://www.biodivcanada.ca/default.asp?lang=En&n=137E1147-0

Beginning of Excerpt

Bovine tuberculosis [Reportable]

Bovine tuberculosis (BTb) is caused by infection with the bacterium *Mycobacterium bovis*. It readily infects domestic cattle, and in people it causes a disease indistinguishable from human tuberculosis (infection with *M. tuberculosis*). Infection generally is permanent if untreated, and disease is prolonged and debilitating or fatal (Clifton-Hadley et al., 2001). Infected animals, meat products, and milk are significant health hazards for people, and for public health reasons, BTb was successfully eradicated from Canada's domestic animal population through a long and costly program of testing all herds and slaughtering entire herds in which any infected animals were detected. Herd slaughter is necessary because the tests for BTb in live animals are unreliable and easily fail to detect infected individuals. These tests are quite accurate, however, when used to identify infected herds. BTb can infect and cause disease in a wide range of mammalian species. However, maintenance of infection in a population appears to require gregarious behaviour which affords the necessary rates of contact to achieve inter-generational infections. These maintenance populations also can provide a constant source of infection for susceptible scavenger species, such as wild or feral pigs, as occurs when these are sympatric with an infected maintenance population (Connelly et al., 1990; Clifton-Hadley et al., 2001).

Bison in Wood Buffalo National Park and adjacent areas (Boreal Plains, Taiga Plains, and Taiga Shield ecozones+) became infected with BTb in the 1920s when an infected herd of over 6,000 plains bison were translocated from the former Buffalo National Park in eastcentral Alberta (Nishi et al., 2006). Infection has persisted in this herd and surveys between 1997 and 1999 found that approximately 49% of these bison were infected (Joly and Messier, 2004a). (These bison also carry bovine brucellosis – see page 15) In the past two decades, other populations of wild bison, apparently free of infection with BTb, have become established in the Taiga Plains, Taiga Cordillera, Boreal Cordillera, and Boreal Plains ecozones+ to the north, west, and south of the range of the infected herds (Gates et al., 2001) (Figure 2). Effective measures to prevent the spread of BTb to these infection-free herds are not in place (Nishi et al., 2006). Thus, the potential spread of BTb from infected to non-infected wild bison, all of which are assessed as Threatened by the Committee on the Status of Endangered Wildlife in Canada, and also to livestock, is a major conservation and socio-economic issue.

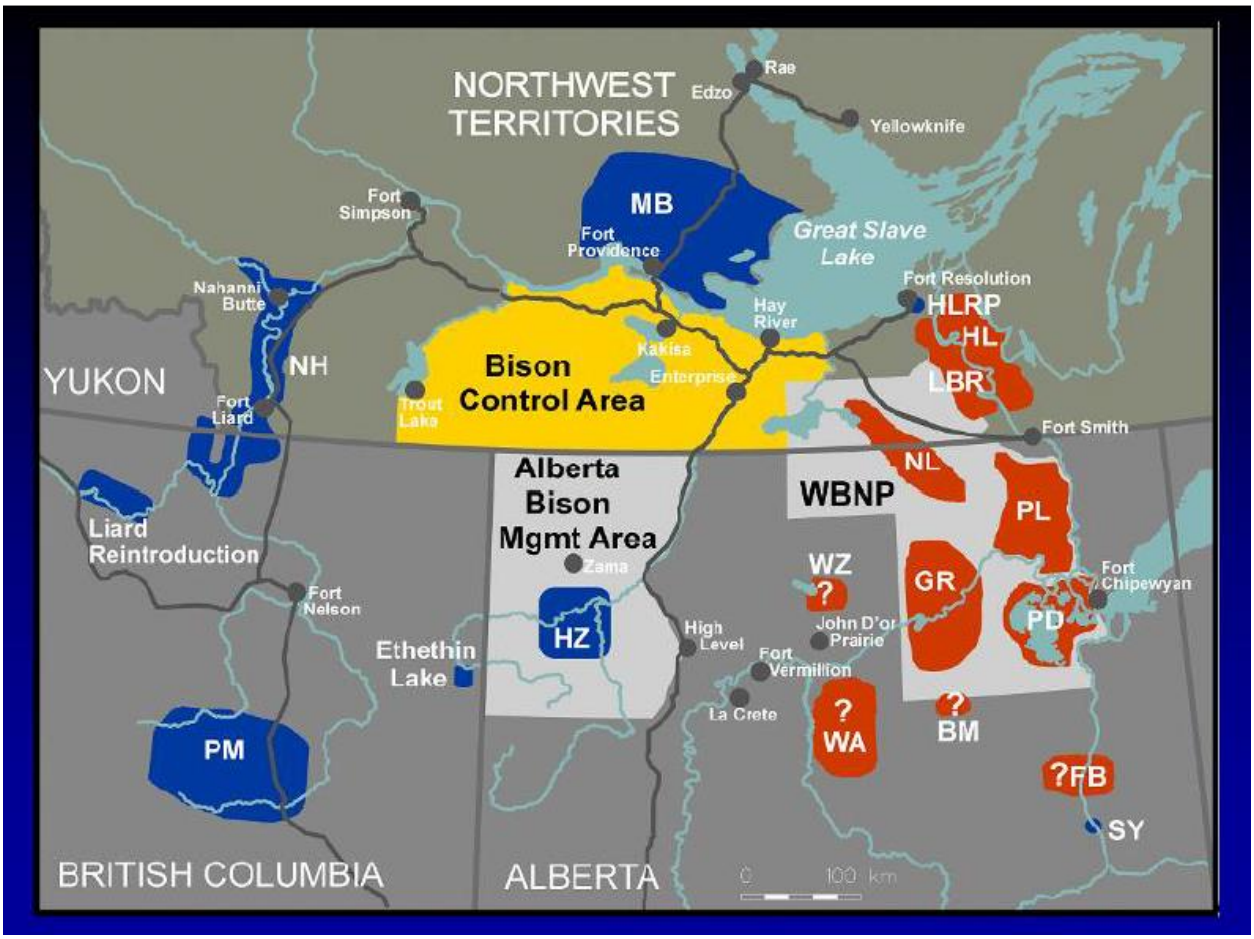

Figure 2. Distribution of bovine tuberculosis-free and diseased free-ranging bison herds in northwestern Canada.
Herds in blue are considered disease-free. Herds in red have had disease presence confirmed or are assumed to be diseased due to movement patterns into areas of confirmed disease status.
WBNP = Wood Buffalo National Park, NH = Nahanni Herd, PM = Pink Mountain, HZ = Hay Zama, GR = Garden River Herd, HLRP = Hook Lake Recovery Project, LBR = Little Buffalo River, MB = Mackenzie Bison Herd, WZ = Wentzel, WA = Wabasca Herd, NL = Nyarling, PL = Pine Lake, PD = Peace Delta, BM = Birch Mountains, FB = Firebag, SY = Syncrude/Fort Mckay, Liard Reintroduction = Norquist herd
Source: Elkin (2008)

The most extensive research on whether or not BTb (and brucellosis) have an impact on the demography of the infected bison herds found evidence that there is a negative impact (the disease alters the predation rate resulting in the predator having a larger impact than would be the case without the disease) and proposed a biological mechanism through which the impact will persist and keep the population well below the carrying capacity of the available habitat (Joly and Messier, 2004b). Others have disputed this interpretation (Bradley and Wilmshurst, 2004). The current rise in the population of infected bison in the area is compatible with either interpretation.

There is agreement among many scientists that BTb (and brucellosis) could be eliminated from wild bison through complete eradication of the infected herds and re-population with bison free of BTb and brucellosis, and also that such eradication is technically possible (Shury et al., 2006). However, the governments of Canada, Alberta, and the Northwest Territories have not yet resolved this issue since it was first fully articulated in 1990 (Connelly et al., 1990; Nishi et al., 2006). It seems certain that without effective intervention of some form, BTb (and brucellosis) will spread to non-infected wild bison herds progressively over time, and that the vast majority of all wild bison in Canada will become infected (Gates et al., 2001). As recent controversies associated with the movement of diseased bison out of Yellowstone National Park in the United States illustrate, infection of wild bison with diseases of major public health and socioeconomic concern can limit the conservation options for this species (Brown, 2008).

BTb was discovered in elk, domestic cattle, and white-tailed deer in the area of Riding Mountain National Park in 1991 (Lees et al., 2003; Nishi et al., 2006). It appears that the bacterium had persisted undetected in this area in cattle and/or elk herds during the eradication program. In 2009, it was estimated that 3.5% of elk and 1% of white-tailed deer in the Riding Mountain National Park area are infected (Shury, T., unpublished data). There is evidence that BTb is maintained in populations of white-tailed deer only under conditions of unusually high population density, such as the large-scale deer feeding programs associated with BTb in deer in Michigan (Miller et al., 2003). This may be a factor in the maintenance of BTb in elk in the National Park area (Lees et al., 2003). Currently, a multi-stakeholder Task Group for Bovine Tuberculosis is taking a range of actions to reduce transmission of BTb among elk and from elk to cattle (Nishi et al., 2006).

Brucellosis [Reportable]

Brucellosis is the name given to all diseases caused by infection with any of the several different species of the bacterial genus *Brucella*. The clinical manifestations of brucellosis are many, but the most common are infection and inflammation of the female and male reproductive tracts with resulting abortion and male infertility, and infection of joints and tendon sheaths resulting in progressive lameness. Infection persists, often for the lifetime of the animal. People are similarly susceptible to infection with *Brucella* sp., and brucellosis in animals with which people have contact is a public health risk (Chan et al., 1989; Forbes, 1991; Thorne, 2001).

In Canadian wildlife, infection with *Brucella* sp. is widespread and of potential ecological and public health significance in three areas: 1) in bison in and around Wood Buffalo National Park, where the bison populations infected with bovine tuberculosis are co-infected with bovine brucellosis caused by *Brucella abortus* (Boreal Plains, Taiga Plains and Taiga Shield ecozones+) (see bovine tuberculosis, above) (Tessaro, 1986); 2) in barren ground caribou populations, and one herd of reindeer near Tuktoyaktuk, Northwest Territories, which are infected with *Brucella suis* biotype 4 across the Arctic, Taiga Cordillera, Taiga Plains, Taiga Shield, and the northern edges of the Boreal Plains, Boreal Shield, and Hudson Plains ecozones+; (Forbes, 1991); and 3) in seals (harbour, harp, hooded, gray, and ringed seals, and walrus) and whales (beluga, narwal) in the Gulf of Maine and Scotian Shelf, Estuary and Gulf of St. Lawrence, Newfoundland and

Labrador Shelves, Canadian Arctic Archipelago, Hudson Bay, James Bay and Foxe Basin, and West Coast Vancouver Island ecozones+ (Forbes et al., 2000; Nielsen et al., 2001).

Bovine brucellosis was eradicated from the Canadian cattle herd in 1985 and now is an issue for bison conservation, human health, and agricultural economies that parallels that posed by bovine tuberculosis (Connelly et al., 1990). Approximately 30% of bison in the Wood Buffalo National Park area are infected (Joly and Messier, 2004a). Brucellosis is widespread in arctic caribou, with 20 to 50% of animals in various herds infected (Leighton, F. A., unpublished data; Koller-Jones, M., pers. comm.). However, its ecological impact, if any, on infected populations is not known. Infection of northern people with this bacterium occurs and is associated with consumption of caribou (Chan et al., 1989; Forbes, 1991). Whether or not *B. suis* biotype 4 is a naturally occurring pathogen in North America or a pathogen introduced from Europe in imported reindeer also is not known. There are no records of this infection in woodland caribou, including the George River herd of northern Quebec. *Brucella* infection in marine mammals was discovered only in 1994 (Forbes et al., 2000) and its importance to wild populations and to human health have not been assessed.

As noted for bovine tuberculosis, it seems certain that without effective intervention of some form bovine brucellosis will spread to non-infected wild bison herds progressively over time, and that the vast majority of wild bison in Canada then will be infected (Gates et al., 2001). This will place bison recovery efforts further at odds with livestock economies and public health interests. Too little is known about the ecology of *Brucella* in caribou or in marine mammals to identify current trends or predict future trajectories. A serological survey of a large herd of reindeer in the western edge of the Arctic Ecozone+ and of a barren ground caribou herd (Kaminuriak) in the Taiga Shield and adjacent Arctic ecozones+ of Manitoba and Nunavut in the 1960s found only 9% of reindeer and 4% of caribou infected (Broughton et al., 1970). The more recent infection rates of 20 to 50% may represent a trend of increasing prevalence. Any environmental changes that increase the overlap of barren ground caribou with woodland caribou carry the risk that *Brucella suis* biotype 4 may become established in woodland caribou populations.

End of Excerpt

Questions to consider:

1. Based upon this short review of bovine tuberculosis, would you consider it a significant risk? To what – livestock health, wildlife health? Human health?

2. "*There is agreement among many scientists that BTb (and brucellosis) could be eliminated from wild bison through complete eradication of the infected herds and re-population with bison free of BTb and brucellosis, and also that such eradication is technically possible (Shury et al., 2006).*"

Wood bison are listed as threatened (a species likely to become endangered if limiting factors are not reversed) under Canada's *Species at Risk Act*. Yet this article is suggesting slaughter of a species at risk. What do you think of this approach to rare species management?

3. The wood bison of northern Alberta are a complex problem, not only because they can carry tuberculosis, but also frequently brucellosis. Between these two diseases, how many co-occurring species may be infected by encounters with infected herds? How do you think this may affect the idea of eradicating infected herds in order to leave only uninfected herds?