No Accident…
Public Policy and
Chronic Wasting Disease

Darrel Rowledge

CONFERENCE ON CHRONIC WASTING DISEASE
Mississauga Ontario — March 15-16, 2019
Science of Governance

Making careful, intelligent decisions to:
Get what we want / Avoid what we don’t

(Foundation of the Public Trust Doctrine)
UK — epidemic of BSE ‘mad cow’ disease

- Millions of animals slaughtered
- Agricultural economies devastated
- Costs were enormous

Official claims transfer to humans not possible… tragically wrong — BSE infected and killed 230 people
Tens of thousands still carry the abnormal protein ???

Toll was limited only because changes in policy and protocol contained the epidemic
2003 single BSE cow in Alberta

- 40 countries ban Canadian beef
- Massive, multi-billion dollar impacts

Again, policy to prevent spread to food and feed chains was vital to protect public interest.

Lessons learned... or not?
Over roughly the same time period, agricultural practices in North America were quietly creating an epidemic of a far more virulent, sister disease: **CWD**.

In 1996, within days of the UK admitting that people were dying of BSE, Canada confirmed CWD on a game farm in SK.

CWD was imported with game farm animals from the U.S.
CWD declared “State of Emergency” 2001

DEPARTMENT OF AGRICULTURE
Office of the Secretary
[Docket No. 01–019–1]

Declaration of Emergency Because of Chronic Wasting Disease

Chronic wasting disease (CWD), a disease of deer and elk, is part of a group of diseases known as transmissible spongiform encephalopathies (TSE’s), a group that also includes scrapie and bovine spongiform encephalopathy (BSE). While considered rare, the incidence of CWD is on the rise among both wild and domestic cervids. The disease, which can cause their death in a few months, poses a significant threat to wildlife and livestock, and must be controlled.
Canada’s Expert Scientific Panel on CWD

Deemed CWD as arguably the greatest known threat to deer.

Urged all necessary means to prevent the spread... “before it is too late.”

2004
Failure to trace the origin (until 2000), allowed the source herd to ship animals to 40 game farms, infecting at least 21.*

*not geographically accurate
Implications of CWD:

- Direct and expanding threat to NA wildlife, to ecosystems, wildlife economies, communities, and First Nation Treaties.
- Threat to multiple species of deer all over the world, known or potentially susceptible to CWD.
- Proven transfer of CWD via plants (on or in), including agricultural crops; threat to North America’s ag markets, and our entire economy.
- CWD presents potential of transfer to humans.
2018 CWD in North America

United Kingdom 229,946 KM²
Colorado 269,837 KM²
Wyoming 253,348 KM²

Distribution of Chronic Wasting Disease in North America
- CWD in free-ranging populations
- Known distribution prior to 2000 (free-ranging)
- CWD in captive facilities (depopulated)
- CWD in captive facilities (current)

All locations are approximations based on best-available information
Problems of Perspective

We don’t see the coming tragedy

“Tragedy of the Commons”
Micro - Market - Myopia

Impairment / blindness of selected focus

Micro: narrow or singular focus

Market: measured in monetary terms

Myopia: short or immediate term
Comprehensive Analysis

- Both narrow and broad views matter
- Business and biology are inseparable
- Both short and long term analyses matter
North American Model of Wildlife Conservation

1. Wildlife as a Public Resource
2. Prohibition on Marketing
3. Allocation by Law
4. Equal Opportunity for All
5. Killing Only for Legitimate Cause
6. Wildlife as International Resource
7. Science as the Basis for Policy
WORLD’S GREATEST
Environmental Success
Sustainable Development
Two additional, almost priceless benefits

1. Habitat and Biodiversity
2. Protect the health of wildlife
“Most, and probably all of the distinctive diseases of civilization have been transferred to human populations from animals.”

William H. McNeill
Plagues and Peoples, 1997

But there’s a mystery...
1. Diseases do not easily transfer between species; in fact the barriers are quite substantial.

2. Even more challenging to have a disease transfer into new species… and then be transferable between individuals of that species.
Patho-genesis

Domestication’s lethal tradeoff...

Disease!

Why?
STRESS
Selection & Husbandry
Selection for docility dramatically reduces brain size

Different regions of the brain have been differentially reduced

<table>
<thead>
<tr>
<th>Region</th>
<th>Rat</th>
<th>Cat</th>
<th>Dog</th>
<th>Ferret</th>
<th>Pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forebrain</td>
<td>10.1</td>
<td>26.0</td>
<td>35.0</td>
<td>36.8</td>
<td>36.0</td>
</tr>
<tr>
<td>Corpus</td>
<td>6.3</td>
<td>-</td>
<td>31.0</td>
<td>32.7</td>
<td>32.6</td>
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<tr>
<td>Midbrain</td>
<td>3.8</td>
<td>-</td>
<td>19.0</td>
<td>17.4</td>
<td>26.1</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>5.7</td>
<td>-</td>
<td>32.0</td>
<td>23.9</td>
<td>26.0</td>
</tr>
<tr>
<td>Medulla callosum</td>
<td>3.6</td>
<td>-</td>
<td>23.0</td>
<td>16.0</td>
<td>24.6</td>
</tr>
</tbody>
</table>

Most pronounced in neocortex

Australian National University
Transport
Domesticating Pathogens, Hosts

- Resistance
- Stress
- Husbandry
- Selection
- Vectors
- Exposure
- Fomites
- Transport
- Anti-paths
- Squalor
- Virulence
Washington State University
sheep co-housing experiment
UC Davis Wildlife Health Center
Final Report 2007, summarized the literature:

“Penned transmission studies indicate that 100% of the bighorn sheep contracted respiratory disease after being co-housed with domestic sheep.”
<table>
<thead>
<tr>
<th>Disease</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>goats</td>
</tr>
<tr>
<td>Measles</td>
<td>cattle</td>
</tr>
<tr>
<td>Mumps</td>
<td>pigs</td>
</tr>
<tr>
<td>Whooping Cough</td>
<td>pigs</td>
</tr>
<tr>
<td>Malaria</td>
<td>fowl / macaques</td>
</tr>
<tr>
<td>Dengue</td>
<td>bats / monkeys</td>
</tr>
<tr>
<td>Cholera</td>
<td>cattle</td>
</tr>
<tr>
<td>Small Pox</td>
<td>camels / rodents</td>
</tr>
<tr>
<td>Typhoid</td>
<td>chickens</td>
</tr>
<tr>
<td>Anthrax</td>
<td>sheep</td>
</tr>
<tr>
<td>Influenza</td>
<td>fowl / swine</td>
</tr>
<tr>
<td>Leprosy</td>
<td>water buffalo</td>
</tr>
<tr>
<td>Common Cold</td>
<td>cattle / horses</td>
</tr>
<tr>
<td>Peptic Ulcers / GI cancers</td>
<td>sheep</td>
</tr>
<tr>
<td>Trichinosis</td>
<td>pigs</td>
</tr>
<tr>
<td>Hepatitis A, E / liver cancer</td>
<td>primates, dogs, pigs, horses</td>
</tr>
<tr>
<td>Marburg / Ebola</td>
<td>monkeys / bats</td>
</tr>
<tr>
<td>AIDS</td>
<td>chimpanzees</td>
</tr>
<tr>
<td>vCJD</td>
<td>cattle</td>
</tr>
<tr>
<td>SARS</td>
<td>palm civets</td>
</tr>
<tr>
<td>MERS</td>
<td>camels</td>
</tr>
</tbody>
</table>
1980s... schemes to change policy—not just to restore markets in dead wildlife—but to privatize and **domesticate** wildlife for profit.

“Game Farming”
Why Game Farm?

- Venison
- Velvet
- Urine
- Shooters
‘Shooters’
Proposal entirely based in economics, but no economic analyses were ever conducted!
Game farming — proven threats

- Diseases
- Parasites
- Genetic Pollution
- Habitat Loss
- North American Model of Conservation
- Economic Costs / Multipliers
- Public Policy / Legal / Social Failures
Health fears soar over elk TB

By Jeff Welke
(Herald writer)

Positive tuberculosis tests in almost 30 percent of game farm workers checked for the disease is hard evidence of a serious, and growing public health threat, industry opponents charged Friday.

And Alberta Health's director of tuberculosis services is urging the province to proceed "very slowly, and very cautiously" in developing the now fully legalized game farming industry.

Dr. Anne Pannier confirmed Friday that of 425 people checked for the disease because of their contact with captive infected elk, 74 have tested positive.

At a Calgary news conference Friday, a day after the provincial government passed an act allowing the commercial sale of elk meat, opponents said the disease will continue to spread.

"People still die from tuberculosis," said Dr. Nada Dangoard, a Calgary physician and president of the Alberta Fish and Game Association.

"For the most part it's treatable, but I'm painfully aware that it can still be fatal," she said, citing an example of a patient he knows who is dying of the disease.

Pannier said only one person - a veterinarian - has so far developed active tuberculosis. But she said the chance of people contracting the disease from the animals is now remote.

"I think there is some risk. Right now it may be small, but it is very real," she said.

Dangoard said that instead of admitting problems have to be studied. Agriculture Canada and Alberta Agriculture are censoring to game farmers and their elk meat and antler business.

"Agriculture is totally committed -- and cattle, wildlife and human health are at risk."

Alberta Agriculture Minister Emile Lebel said Friday that the bovine TB outbreak in game farm elk, first identified last fall, is now "completely under control.

Agriculture Canada is trying to wipe out TB in Alberta's 4,000 elk with a control program that may eventually see as many as 2,000 slaughtered. The disease has been confirmed on seven of 107 game farms in the province.

Valentino Girola, a wildlife management expert and professor at the University of Calgary, said elk present unique problems in disease control. "We're not dealing with livestock. These aren't traditional domestic animals; these are animals with a completely different biochemistry."

"There is no animal better at spreading TB than elk," he said, explaining that the virus spreads from diseased animal faces and runway areas that contaminate grass eaten by other elk.

See Elk, Page A2
Spring 1996

vCJD

CWD
Prions as Domestic Disease

• No Evidence of **SCRAPIE** in wild sheep (before Robert Bakewell)
• No Evidence of **BSE** in wild bovids (before cows were fed to cows)
• No Evidence of **CWD** in wild cervids (before mule deer in captivity)
No Accident...

Public Policy and Chronic Wasting Disease in Canada

Darrel Rowledge

prepared for
Alberta Professional Outfitters Society
November, 2008
CWD a failure of governance not science
Prion uptake from contaminated soil:

Root uptake to aerial tissues (stems and leaves) various plants present a previously unrecognized risk of human and domestic exposure to disease agents

Title: Uptake of Prions into Plants

Author(s):
Christopher Johnson
U.S. Geological Survey, Madison, WI,
Contact: cjjohnson@usgs.gov

Abstract (emphasis mine):
Chronic wasting disease (CWD) and scrapie-infected animals shed infectious prions during both the preclinical and clinical phases of disease. Contamination of environments with prions released from animals or from infected carcasses appears to contribute to the transmission of these diseases. Previous work has suggested that soil may serve as an environmental disease reservoir. Vegetation is ubiquitous in CWD-contaminated environments and plants are known to absorb a variety of substances from soil, ranging from nutrients to contaminants.

The uptake of proteins from soil into plants has been documented for many years and we have been investigating the uptake of prions into plants in vitro. Using laser scanning confocal microscopy, we observed root uptake of fluorescently-tagged, abnormal prion protein in the model plant Arabidopsis thaliana, as well as the crop plants alfalfa (Medicago sativa), barley (Hordeum vulgare) and tomato (Solanum lycopersicum).

Using serial protein misfolding cyclic amplification, a sensitive biochemical prion detection method, we have found evidence of prions in aerial tissues from these species, as well as maize (Zea mays). Both stems and leaves of A. thaliana grown in culture media containing prions are infectious when injected into mice and oral bioassays are underway for A. thaliana and other plants.

Our results suggest that prions are taken up by plants and that contaminated plants may represent a previously unrecognized risk of human, domestic species and wildlife exposure to CWD and scrapie agents.

Prion contamination on plants:
CWD prion contamination on roots and leaves of plants can efficiently bind and carry infectivity and may play an important role in horizontal transmission by oral intake of the prion agent.

Title: AD.82:
Prion-contaminated plants can transmit prion disease

Authors:
Sandra J. Pritzkow, Rodrigo Morales, Fabio Moda and Claudio Soto
University of Texas Medical School at Houston; Houston, TX USA

Abstract (emphasis mine):
Chronic Wasting Disease (CWD) is a prion disorder affecting deer and elk. The efficient propagation of this disease in captive and free-ranging animals suggest that it may involve horizontal transmission through contaminated environment. It has been shown, that infectious prions can enter the environment through saliva, feces, urine, blood or placenta tissue from infected animals, as well as by carcasses from diseased animals. Various studies have demonstrated that infectious prions bind tightly to soil and remain infectious after years in this material.

We hypothesize that plants, which get in contact with infectious prions, can also play a role on the horizontal transmission of prion diseases. To study whether plants can interact with prions, we analyzed wheat grass roots and leaves incubated with 263K-infected brain homogenate in vitro using the PMCA technique and in vivo in Syrian hamsters.

For in vitro analyses, the plant tissue was incubated in serial dilutions of 263K-brain homogenate, washed thoroughly and analyzed for the presence of Prpsc by PMCA.

The results show that even highly diluted Prpsc can bind to roots and leaves and sustain the conversion of normal prion protein. Similar experiments are currently ongoing using CWD infected material.

In vivo, hamsters were orally infected with leaves or roots incubated in 10% 263K-infected brain homogenate, which were thoroughly washed as well. Hamsters, inoculated with 263K-contaminated roots or leaves, developed typical signs of prion disease, whereas control animals inoculated with non-contaminated plants did not. Prion disease was confirmed by immunohistological and biochemical analyses.

These findings suggest that plants (leaves and roots) can efficiently bind infectious prions and act as carrier of infectivity and may play an important role in horizontal transmission by oral intake of the prion agent.
CWD Susceptible Eurasian Wildlife

- Moose
- Red Deer
- Reindeer
- Muntjac Deer
- Felids
- Sika Deer
- Mice / Voles
The Challenge of CWD: Insidious and Dire

Only immediate action will avoid catastrophic outcomes

Valerius Geist, Professor Emeritus, University of Calgary
David Clausen, (former) Chair, Wisconsin Natural Resources Board
Vince Crichton, (former) Co-Chair, Canada’s National Wildlife Disease Strategy
Darrel Rowledge, Director, Alliance for Public Wildlife

URGENT
Fall 2018 Norway announced

“Hay and straw from the United States and Canada must also be accompanied by a certificate from a public veterinarian that the product has been harvested in states or provinces where no Chronic Wasting Disease has been detected.”

This will only expand and spread.
Vital Actions Needed

1. Contain the geographic spread of CWD by enacting and enforcing an immediate ban on the movement of all live cervids, all potentially CWD-infected carcasses, animal parts, products, exposed equipment, or other sources of infectious materials.

2. Mandate and implement for hunters, convenient cost-free, rapid testing of all animals harvested from CWD-affected areas.

3. Ensure that no CWD-infected material reaches the food or feed chains, and is instead properly disposed of.

4. Establish and fund accountable research and science-based policy to protect public interest (health, wildlife and related industries, agriculture, our economies and communities).
Two Choices

1. Vital actions and precautionary measures to contain harm and risk—based on established certainties (known causes, impacts, threats, potential outcomes, and cascading effects), while evaluating uncertainties and potential wildcards.

2. Launch further study into uncertainties—even if there is no capacity to change the certainties or vital actions required, while amplifying impacts and increasing the probability of threats and worst case outcomes.
Official policy (most of North America)

Continue to foster and spread CWD
We have not yet seen a human case of CWD, and there is not yet proof that we will.

There is only a potential of transfer.
“Potential” is a *limiting modifier.*

Scientifically, a *one-way modifier.*
Things can only get worse.
Obligations of Governance
Required by Public Trust

- Precautionary Principle
- Accountability - Polluter Pays
The Precautionary Principle:

Where there is a potential for severe or irreversible harm, especially to public wellbeing and interest, an absence of scientific consensus or proof of harm cannot be used to allow or maintain policies or actions underlying the risk.

In such cases, the burden to 'prove safety' falls on those advocating the potentially harmful policy or action.
Accountability of Public Trust

At least fifteen top officials in Michigan face felony charges, including involuntary manslaughter over the decision to switch Flint’s water.
Nature vs. Humans, 2008
(Total Global Mass of Land and Air Vertebrates)

Recreated from Dr. Paul MacCready TED

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Tragedy or Triumph ?
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