Chronic wasting disease: epidemiology and management in wild cervids

Trent Bollinger, BSc, DVM, DVSc

Professor and Regional Director, Canadian Wildlife Health Cooperative

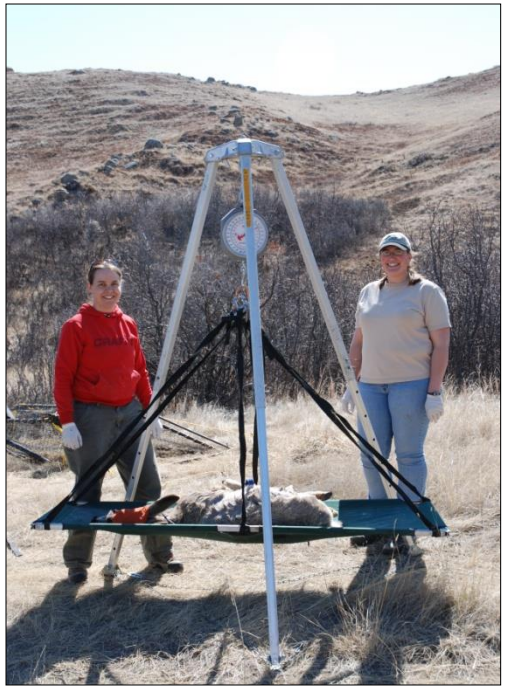
Department of Veterinary Pathology, WCVM, Saskatoon

Capture for radio-telemetry

Netgun

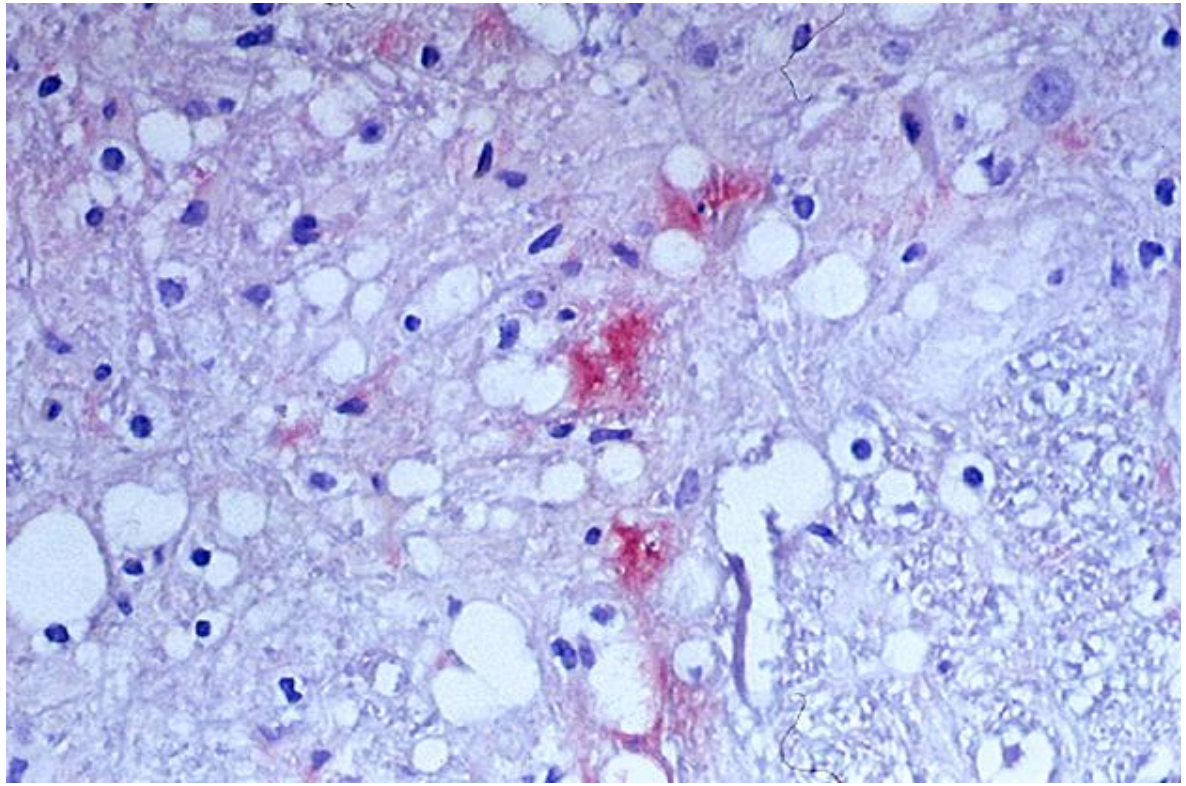
Clover trap

Capture



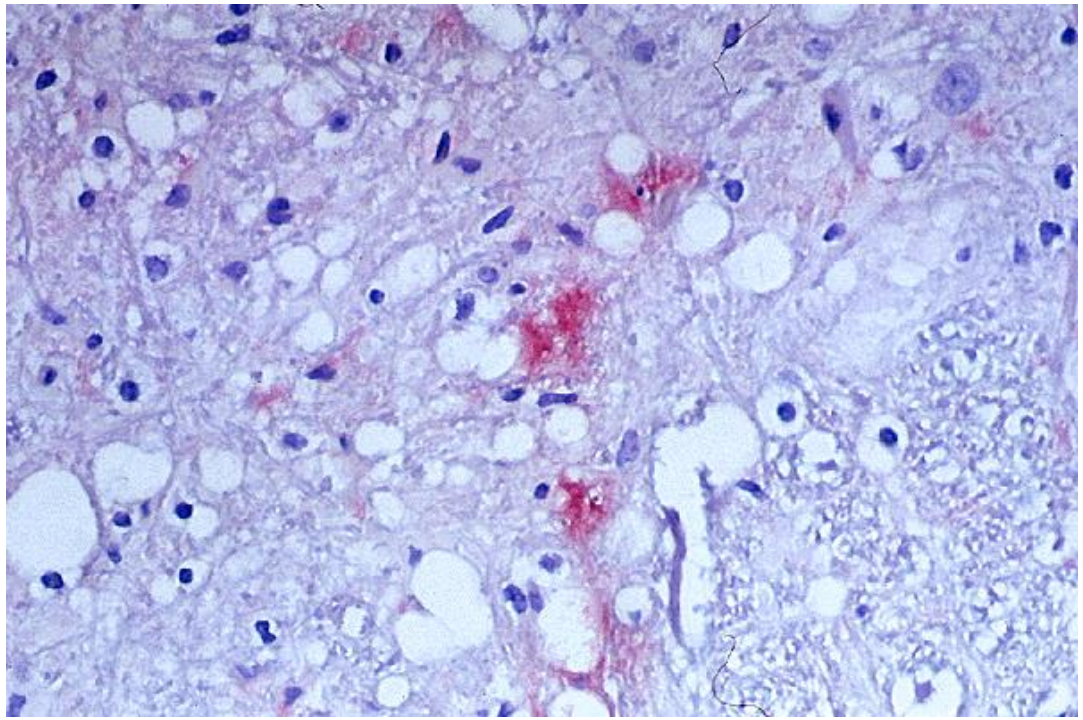
CWD is a spongiform encephalopathy

- The TSEs include disease such as: scrapie, Creutzfeldt-Jakob disease (CJD), kuru, transmissible mink encephalopathy, bovine spongiform encephalopathy (BSE) and CWD
- All are progressive, neurodegenerative diseases characterized by vacuoles in the brain which are invariably fatal.

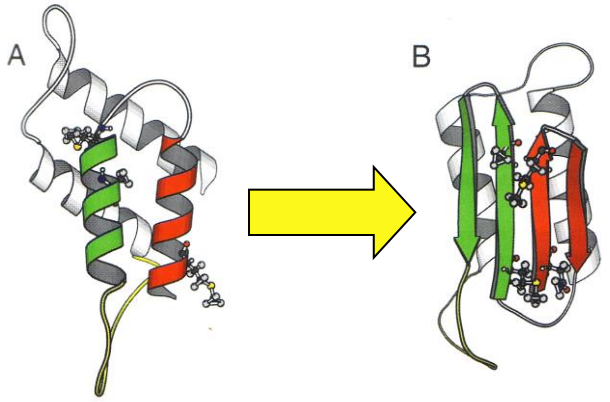


Etiology or cause of TSEs

- Caused by a proteinaceous infectious particle called a prion which induces alterations in conformation of a cell-surface glycoprotein causing it to accumulate in the brain and in other tissues (Prusiner, 1982)



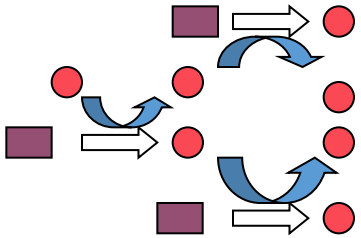
CWD is a transmissible spongiform encephalopathy (TSE)



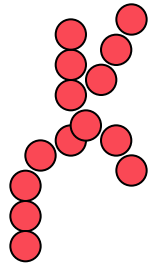
PrP^{C} PrP^{Sc}

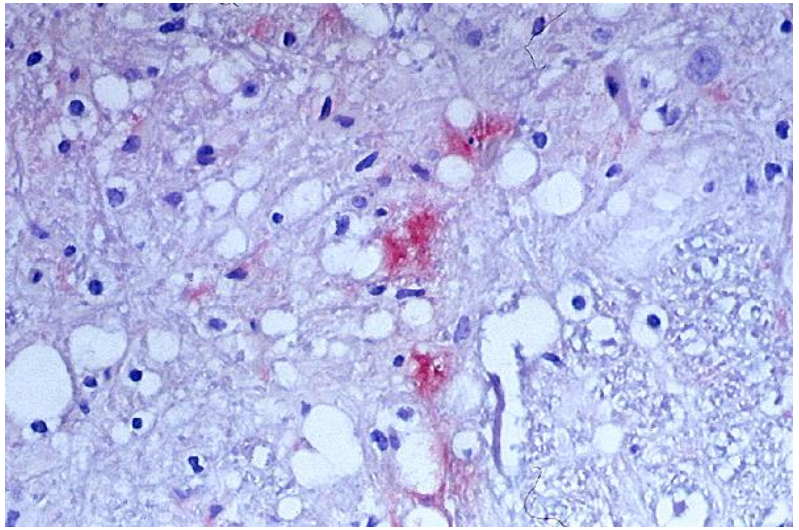
(Prusiner, 1999)

1. Resistance
   (β-pleated sheet)
2. Replication



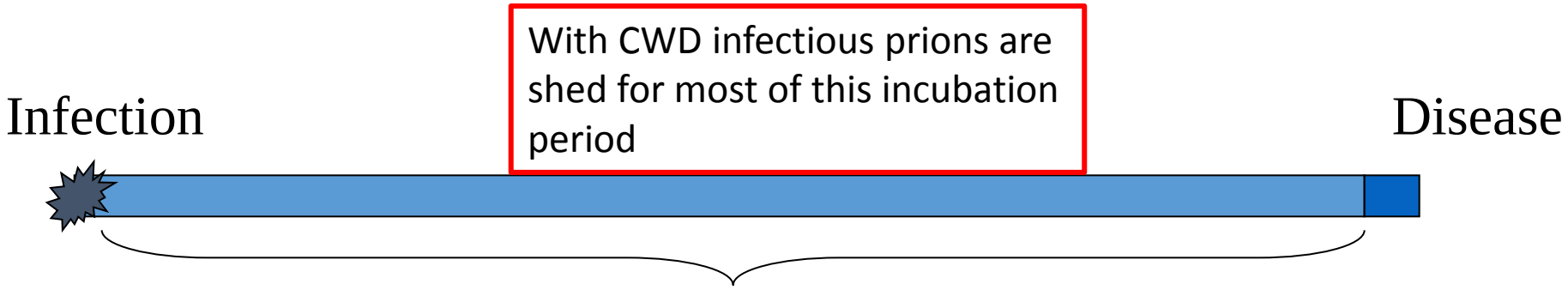
3. Aggregation

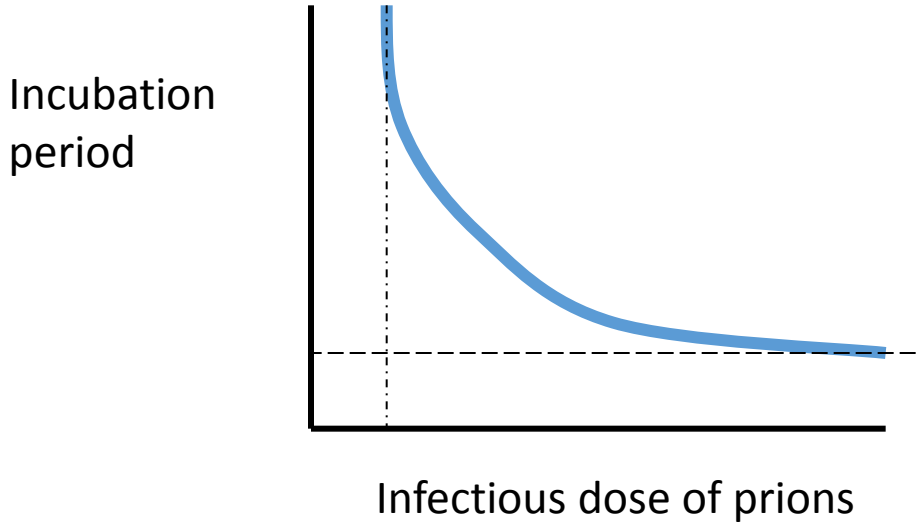


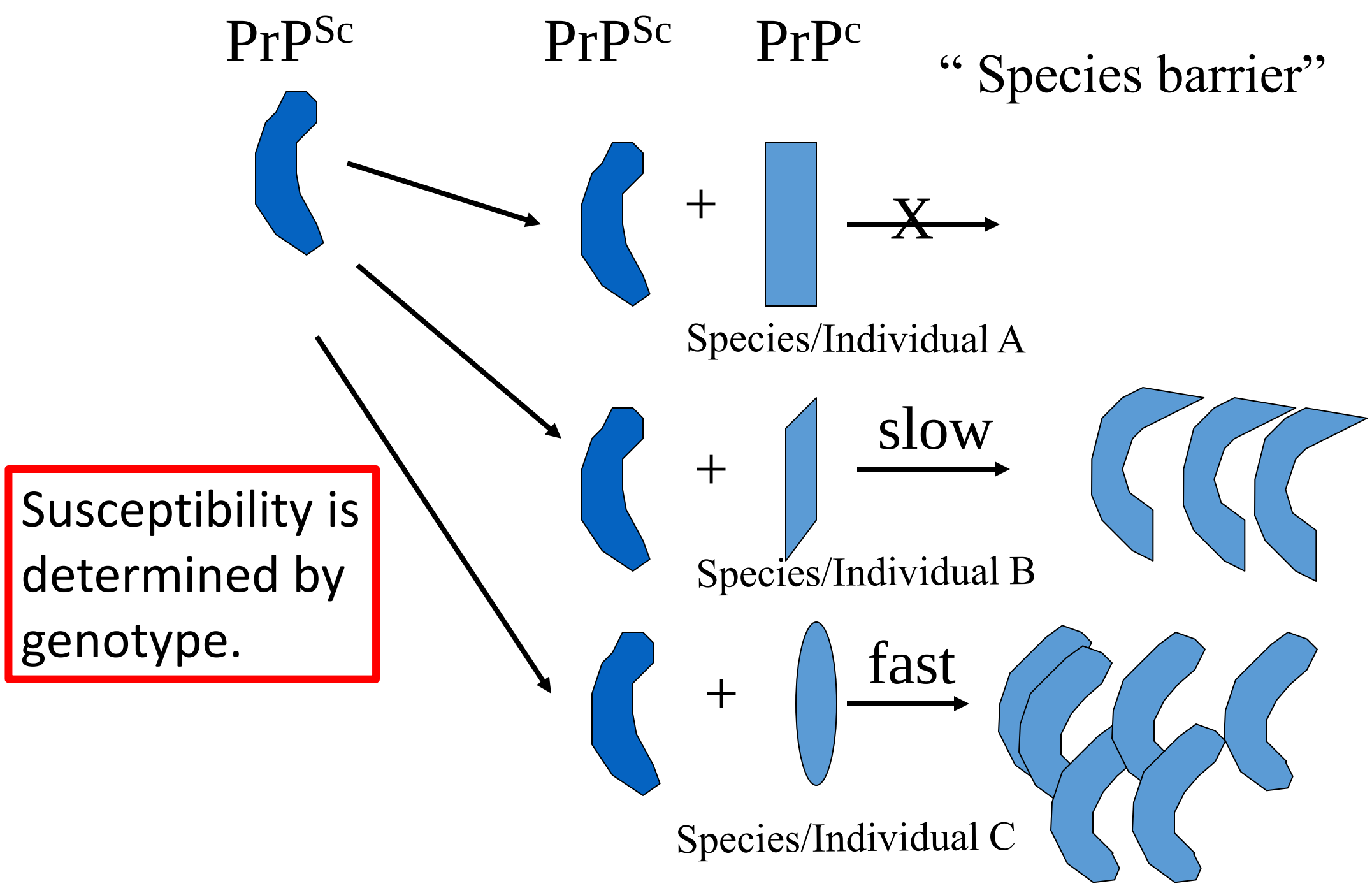


Accumulation of prions in the brain of a deer with associated vacuolation of neurons

Incubation period is Long and Dose-Dependant






PrP^Sc
PrP^Sc
PrP^C
" Species barrier"
+
X
Species/Individual A
+
slow
Species/Individual B
+
fast
Species/Individual C
Susceptibility is determined by genotype.

Sheep Natural Scrapie

13 months

Mice 1st passage

6 m

Mice 2nd passage

4 m

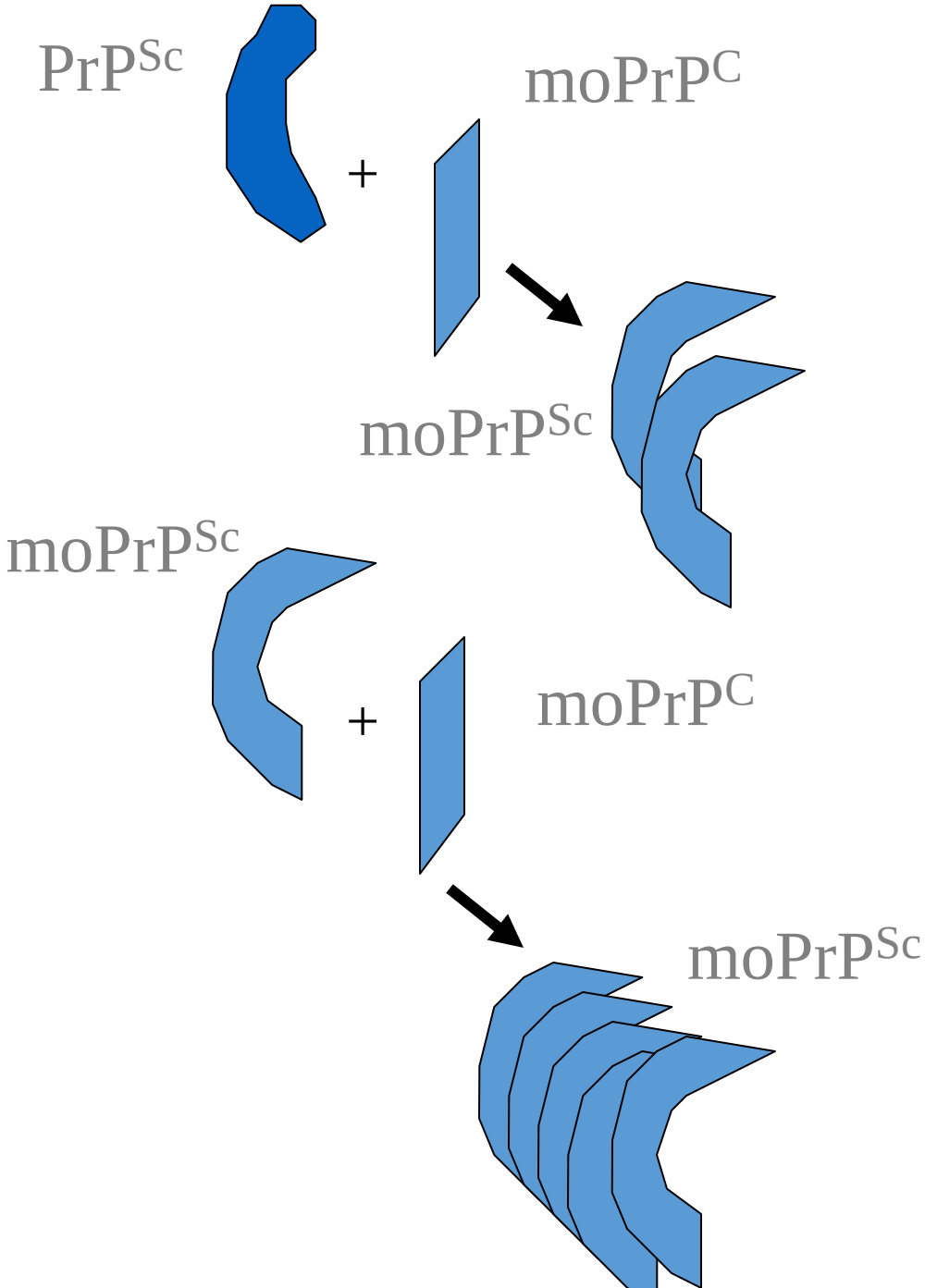
Mice 3rd passage

4.5 m

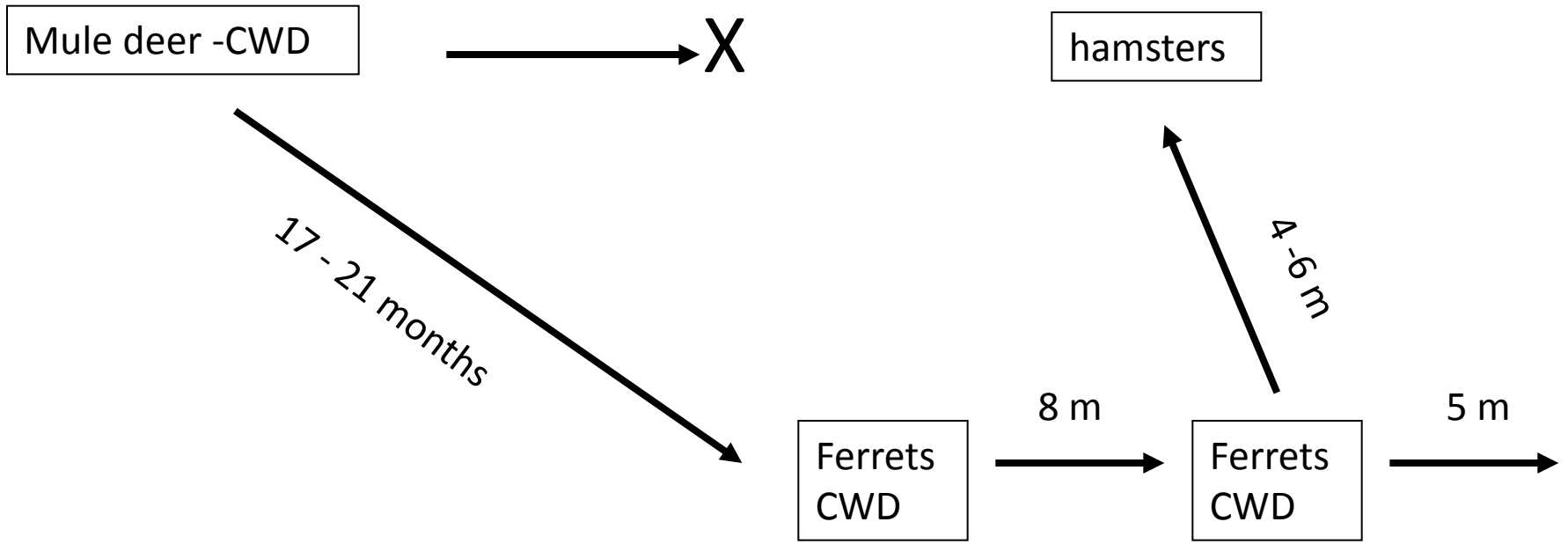
Mice 4th passage

5 m

Mice 5th passage



Types of species susceptible to a prion isolate can be altered by transmission of prions to other species



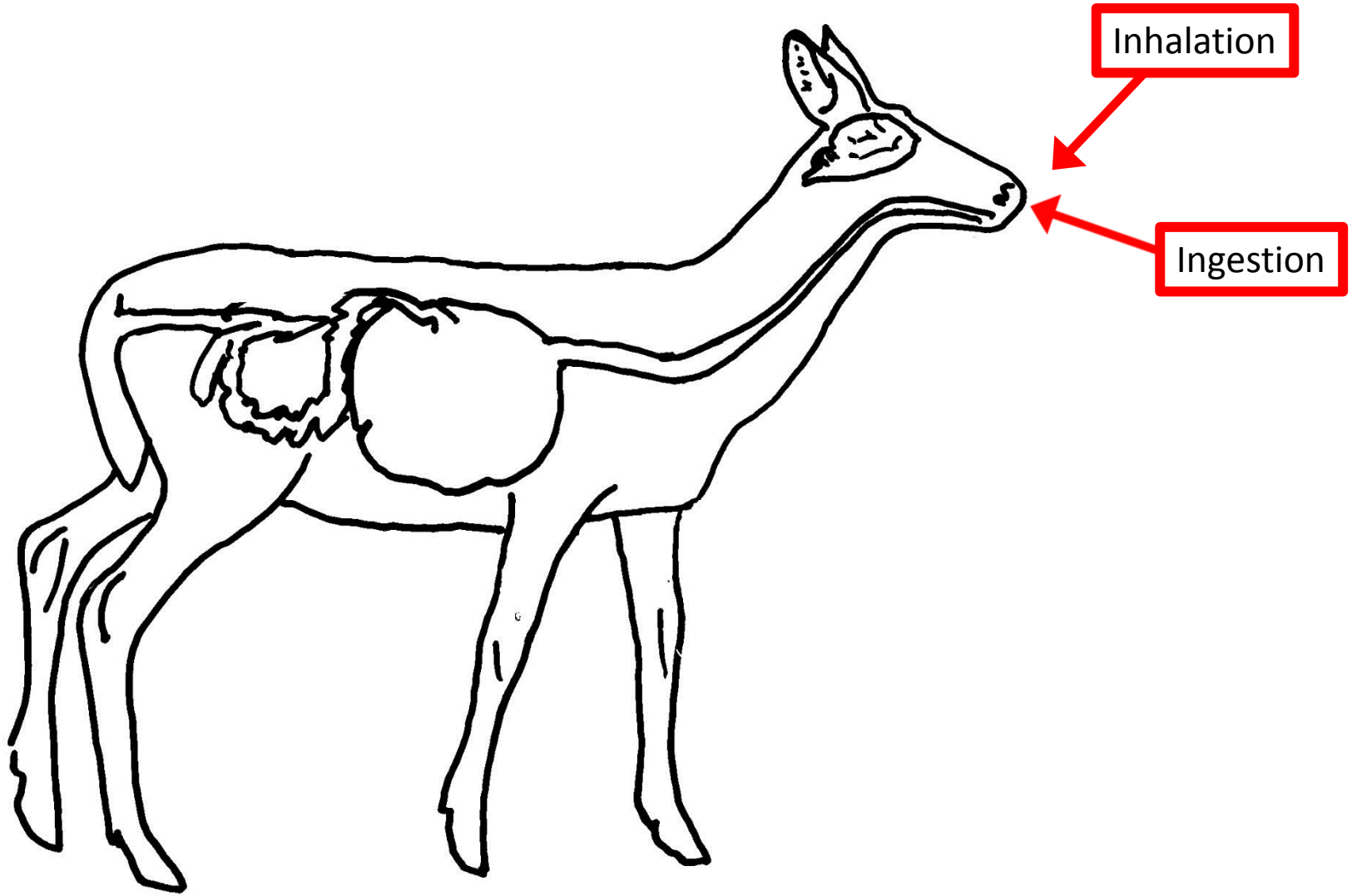
Bartz et al, 1998, Viroloy 251(20)

Three types of TSEs

1. Spontaneous
   - CJD
   - Familial forms
   - Atypical scrapie (Nor-98)
2. Transmissible but not contagious
   - BSE
   - Transmissible mink encephalopathy
3. Contagious
   - Scrapie - sheep
   - CWD – mule deer, white-tailed deer, elk, moose, caribou

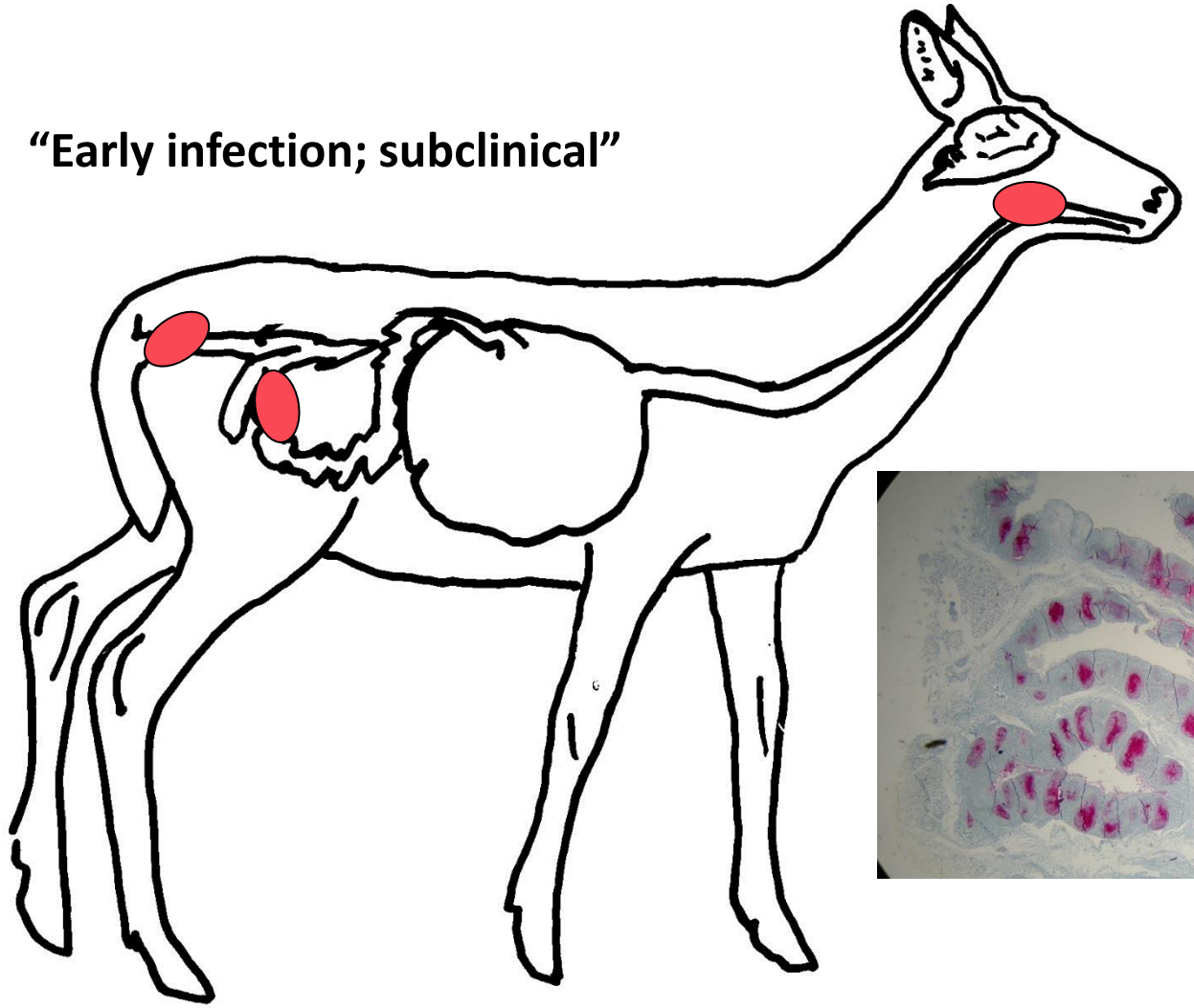
http://www.mythosfarm.com/scrapie--your-herd.html

CWD infection in the cervids



CWD infection in the host

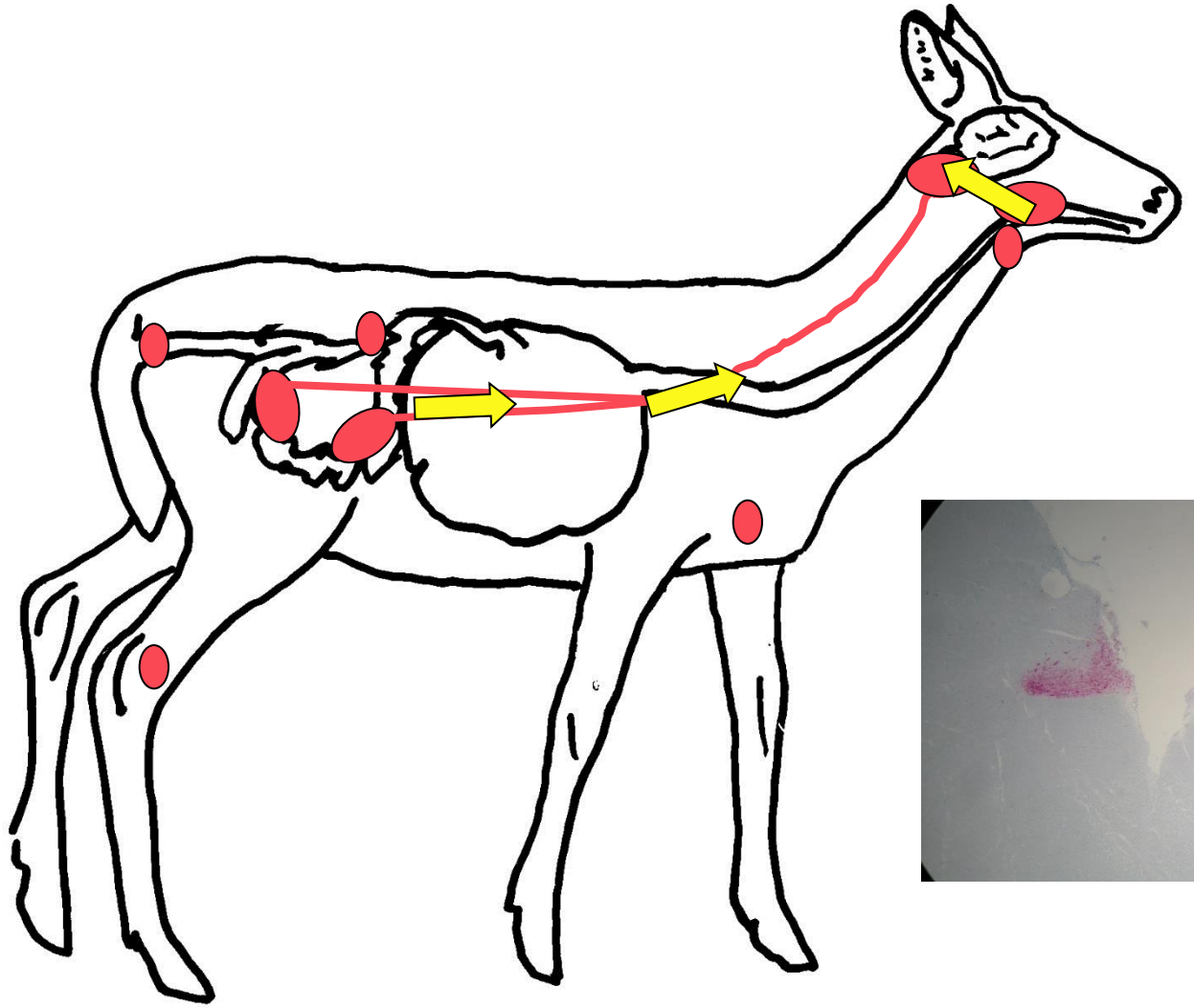
“Early infection; subclinical”



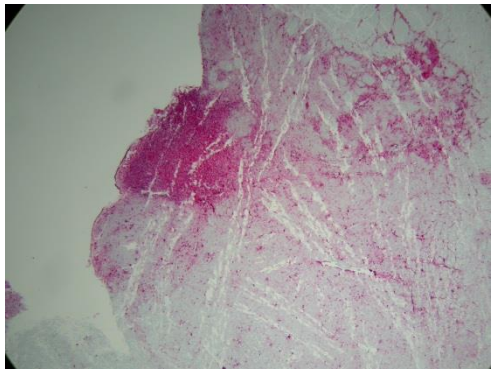
Prions shed in urine, feces and saliva

CWD infection in the host

Prions shed in urine, feces and saliva

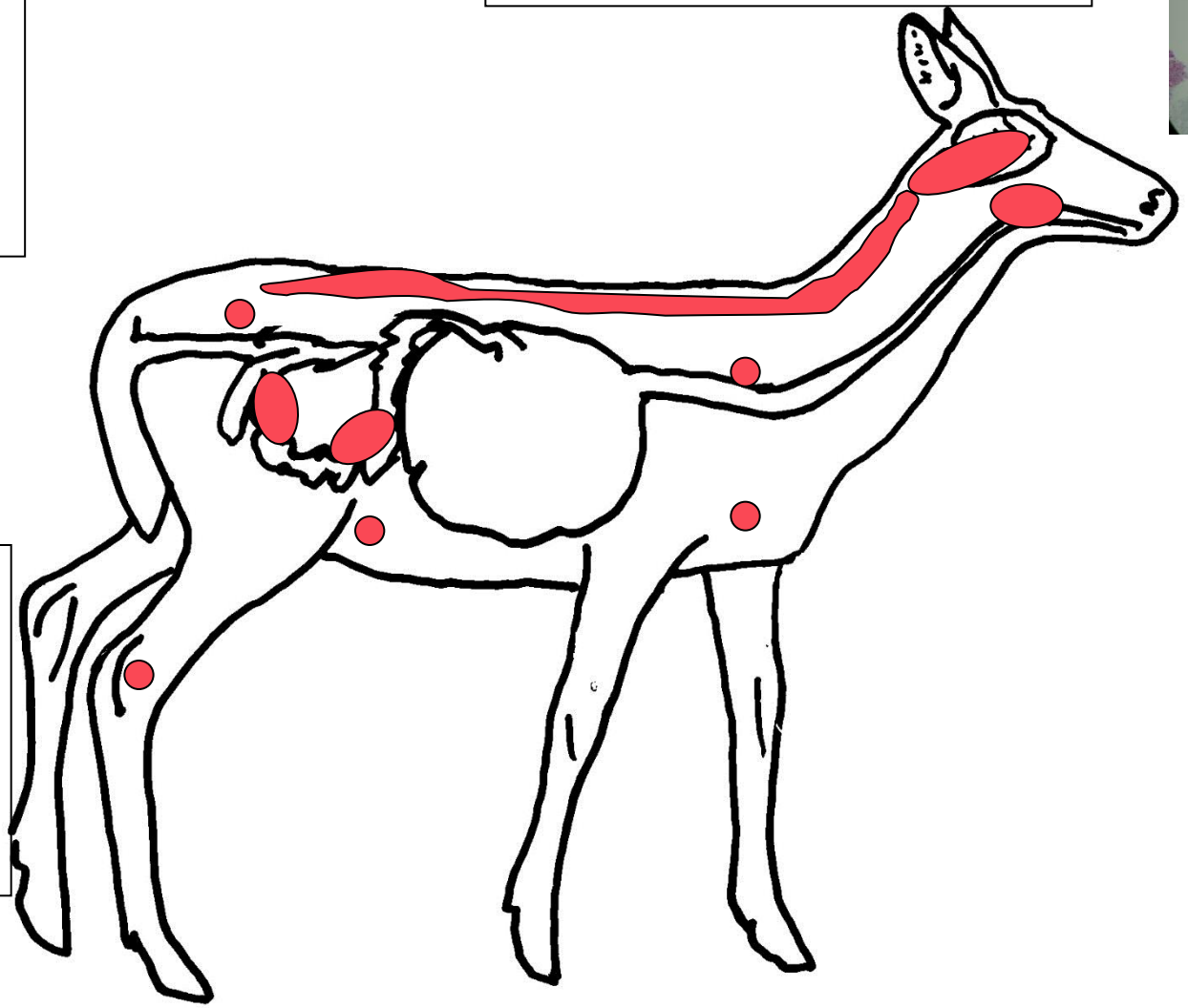


CWD infection in the host



“late infection; clinical”

<u>CWD agent accumulates at high levels in:</u>
Brain
Spinal cord
Lymph nodes

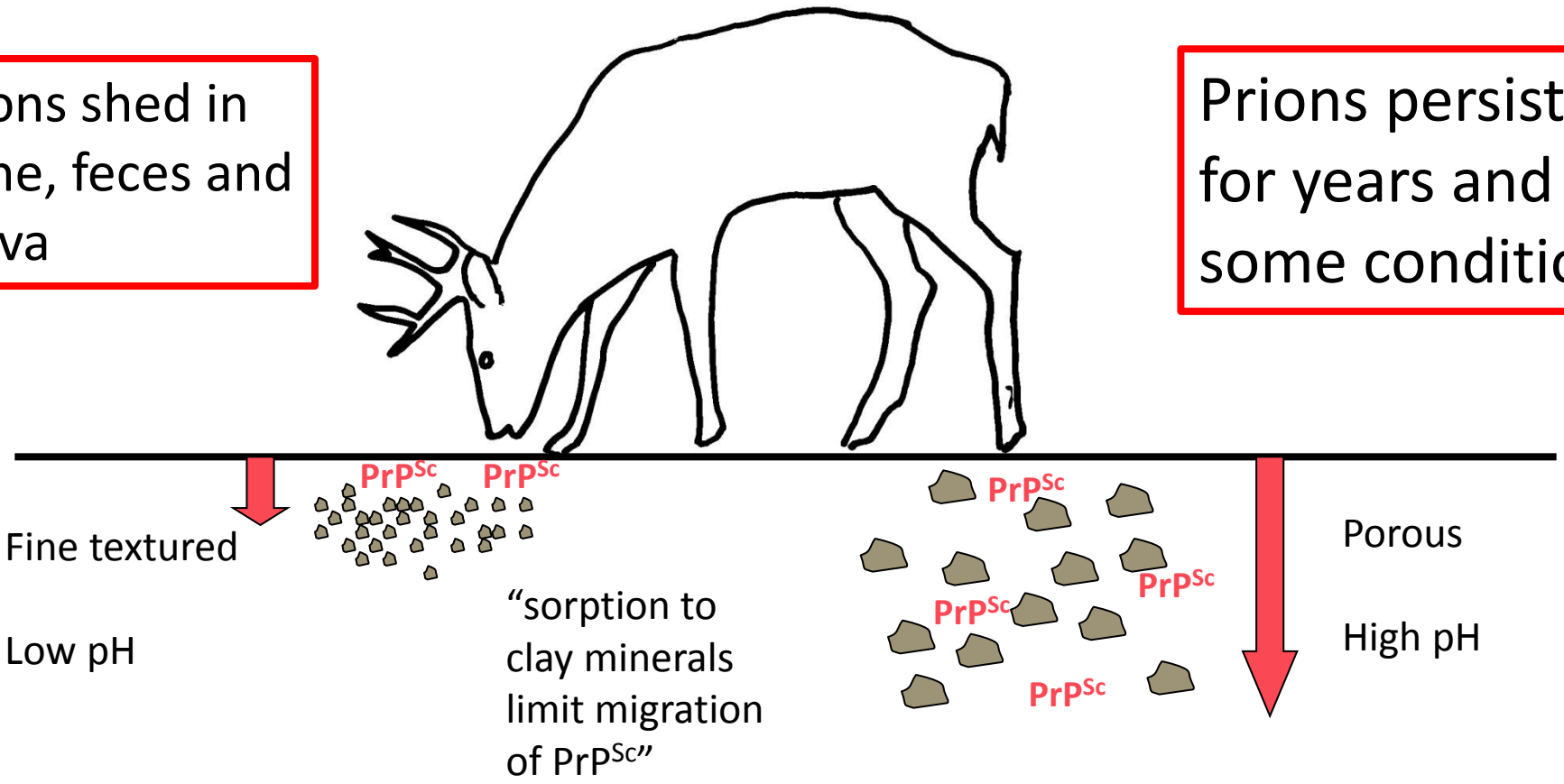


Prions shed in urine, feces and saliva

<u>CWD agent detected at low levels in</u>:
Heart muscle
Blood
Skeletal muscle
Likely all tissues

Mobility of prions in soil

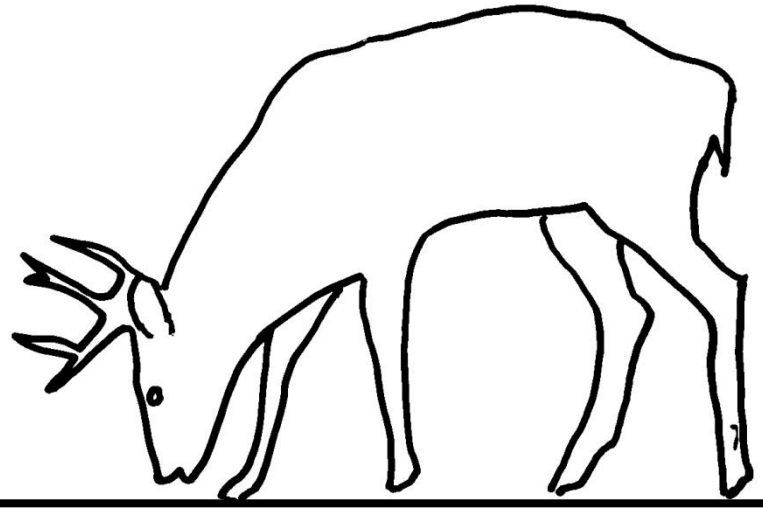
Prions shed in urine, feces and saliva



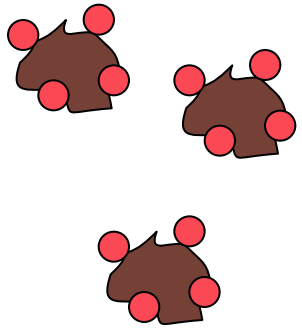
Prions persist in soil for years and under some conditions longer

"Adsorption of pathogenic prion protein to quartz sand" (Xin et al, 2007)

Prions in soil



● = PrP^{Sc}



<u>Montmorillonite clay</u>
Kaolinite clay
Quartz microparticles
4 whole soil samples

PrP^{Sc} tightly bound and Infectivity enhanced

(Johnson et al., 2007)

All adsorb PrP^{Sc} and are infectious

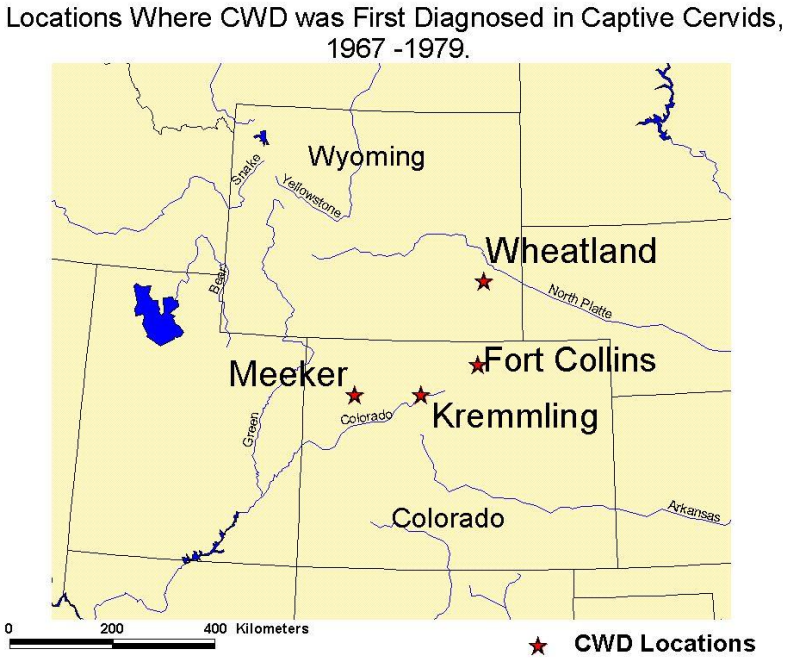
(Johnson et al., 2006)

Summary

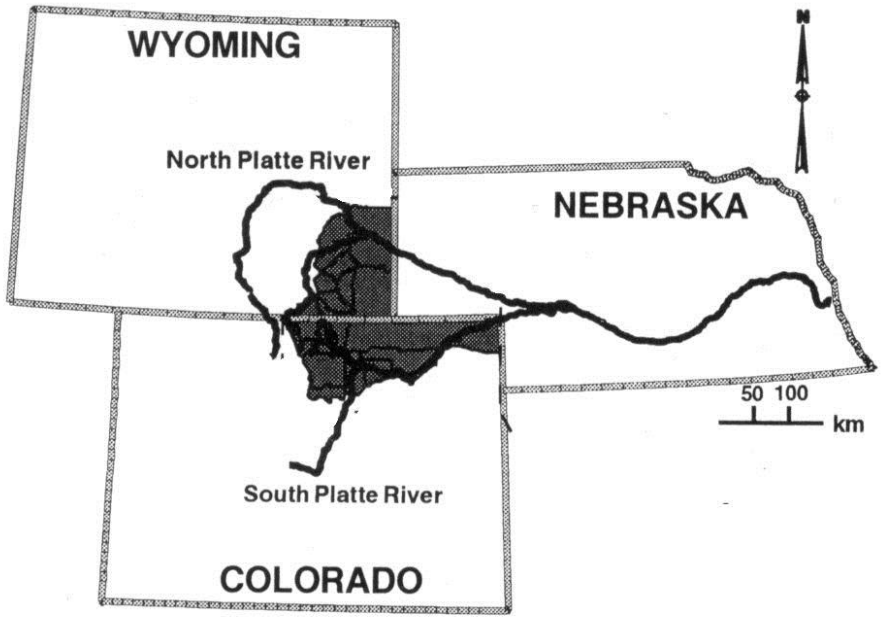
- Prions shed in saliva, urine and feces – shed for long periods
- Transmission by animal to animal contact and contact with contaminated environment
- Prions in environment persist for years
- Potential for development of strains and new variants

History of CWD

- First recognized as a clinical entity in the late 1960s in captive mule deer and elk in Colorado and Wyoming; confirmed as a TSE in late 1970s



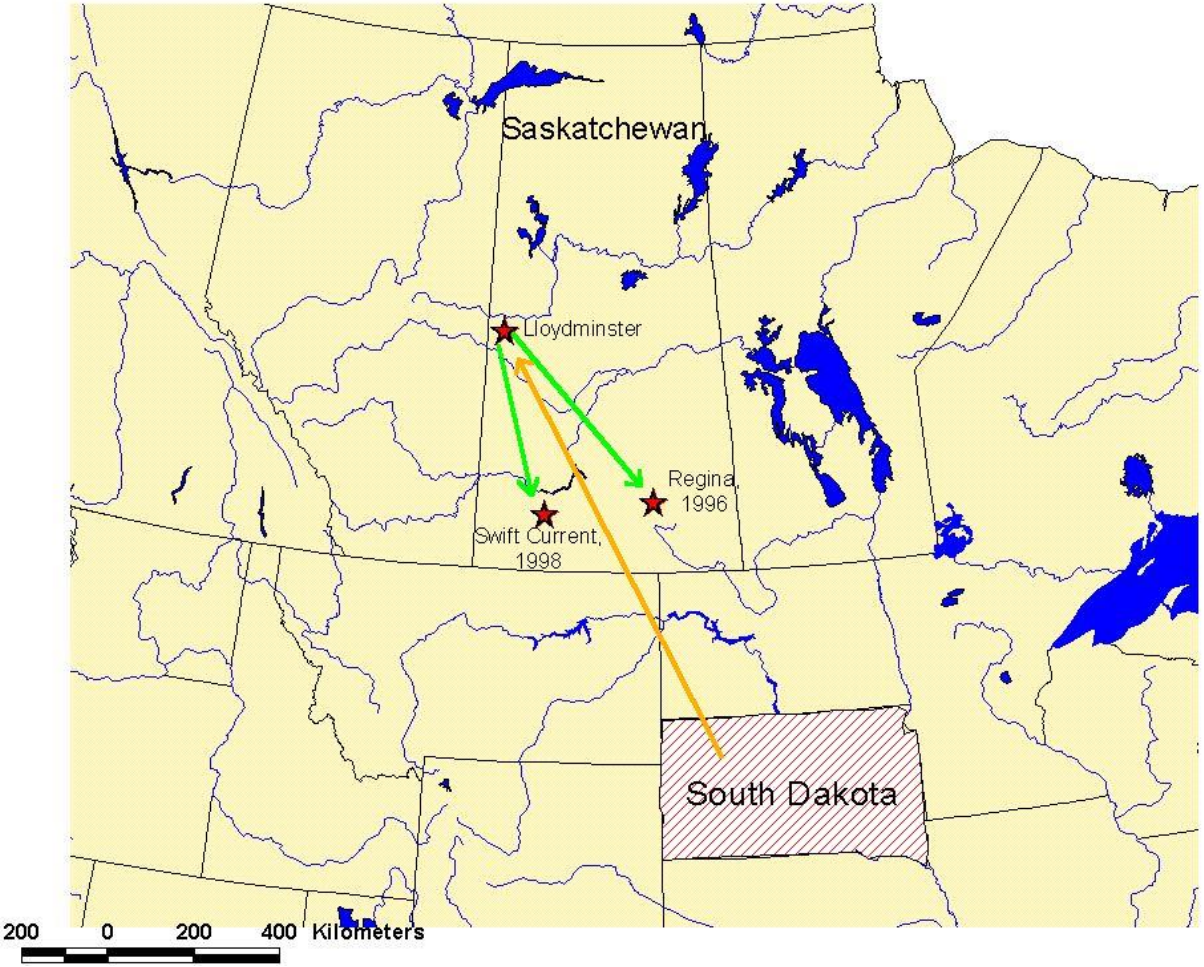
CWD-endemic portions of Colorado and Wyoming, USA



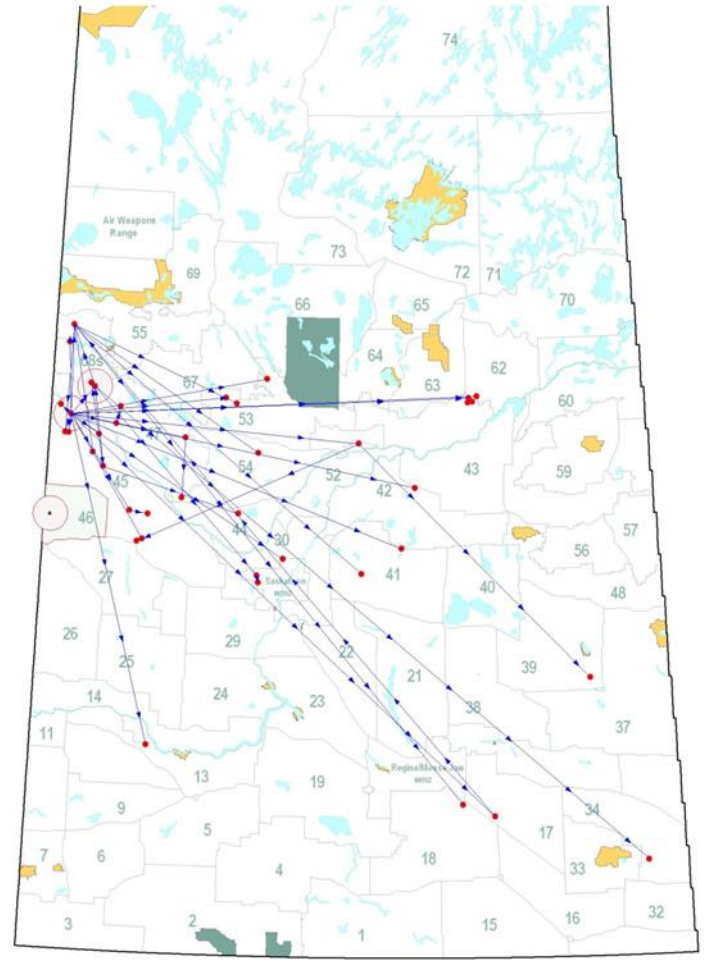
- Estimated overall prevalence in endemic areas of Colorado and Wyoming was 4.9% in mule deer, 2.1 % in white-tailed deer and 0.5% in elk.

Miller et al, 2000

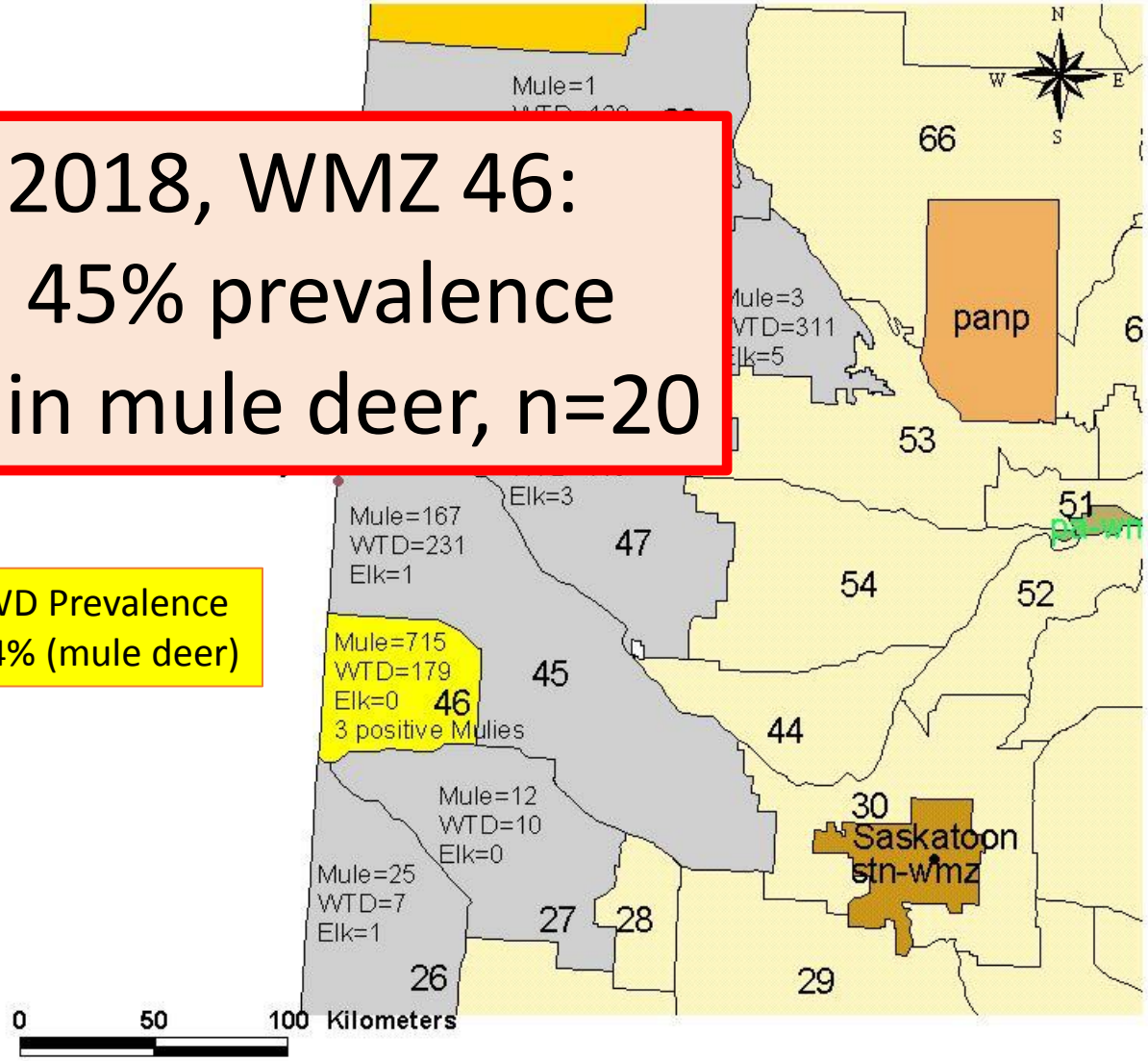
CWD Index Cases in Saskatchewan



Positive Chronic Wasting Disease Locations
Tree of Infection



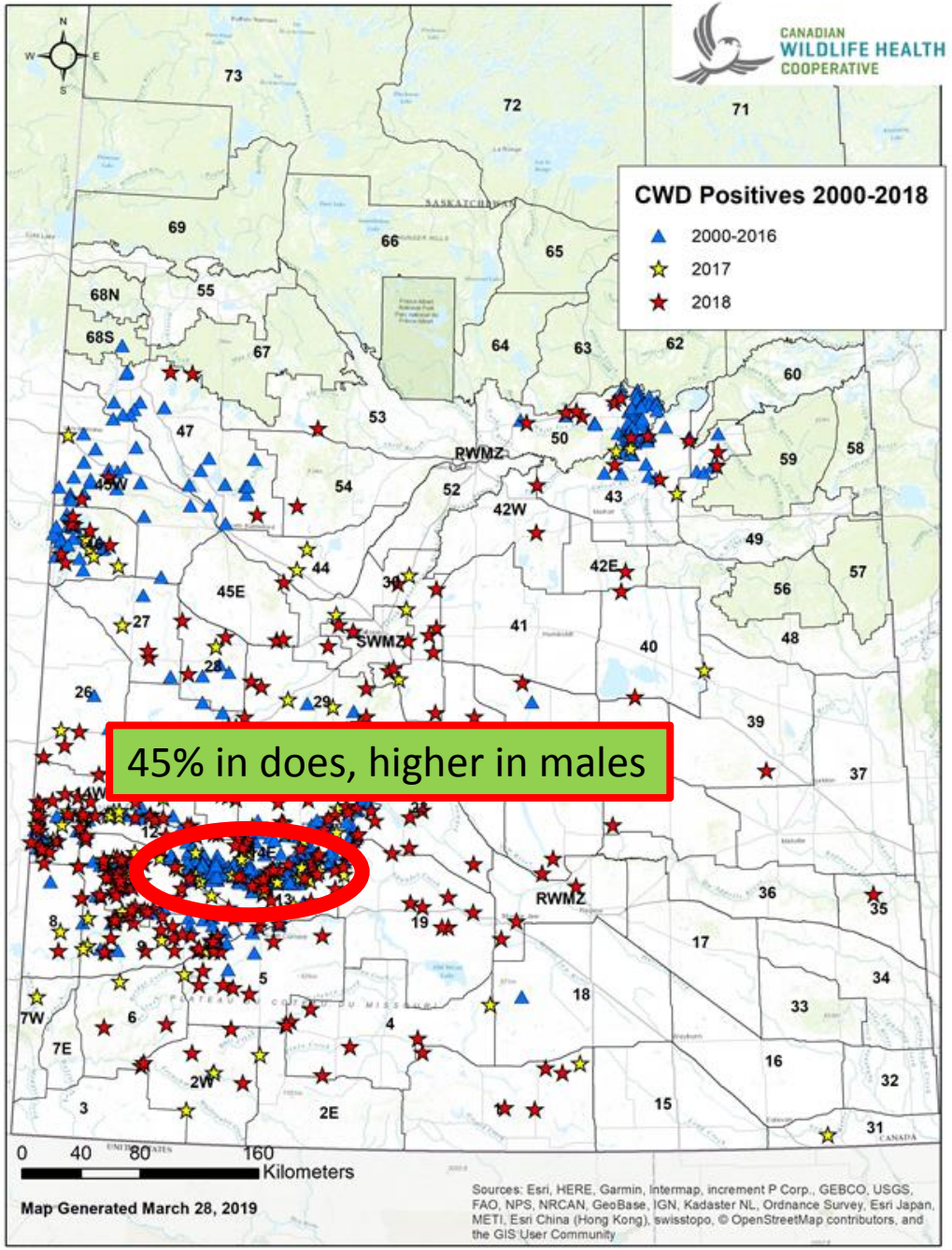
Number of Cervids Collected for CWD Assessment in Western Saskatchewan, 1997-2002.

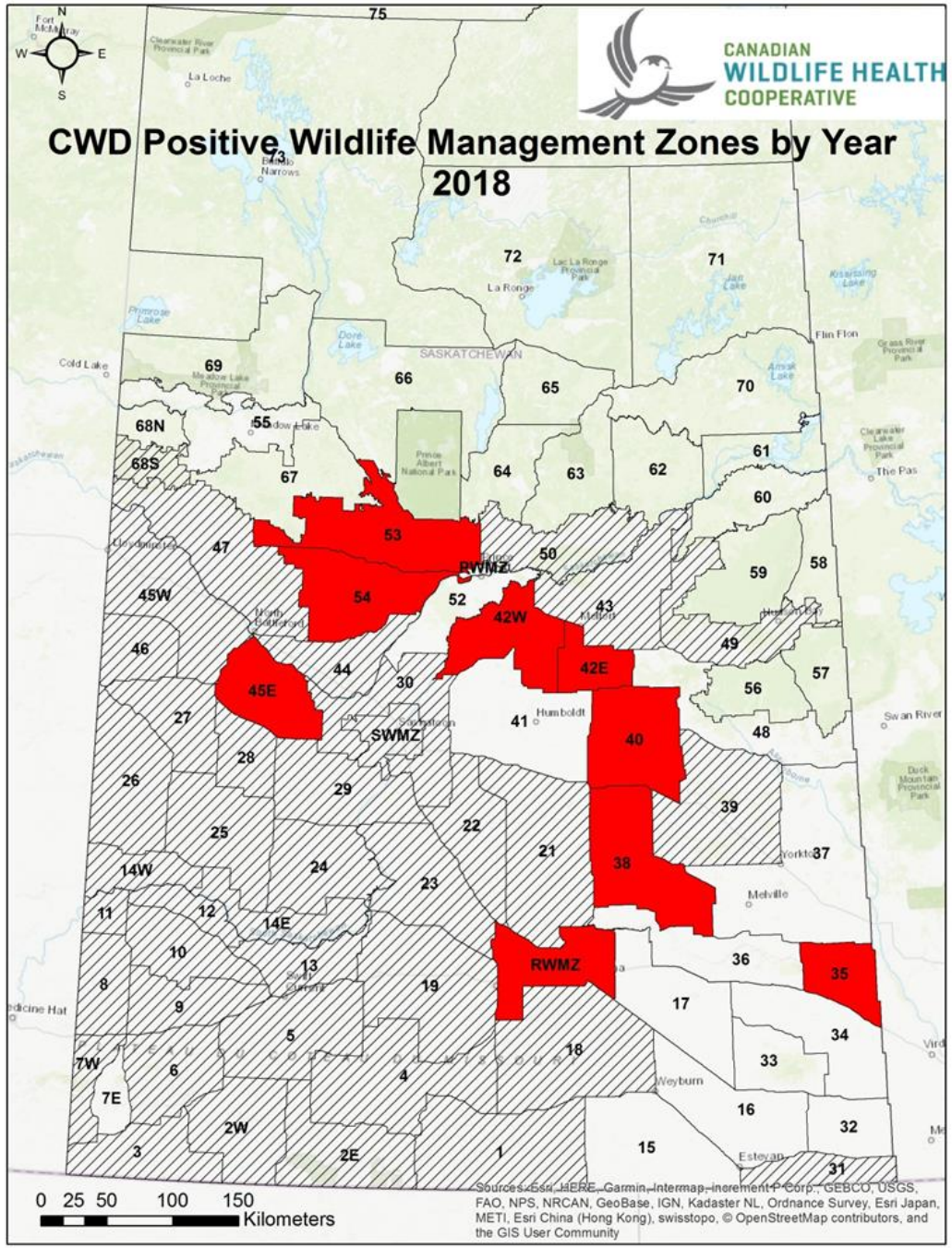


2018, WMZ 46:
45% prevalence
in mule deer, n=20

CWD Prevalence
0.4% (mule deer)

Year	WTD	MD	Elk	Total/year	Test Neg.	Test Pos.
1997	36	2	0	38	all	none
1998	18	91	2	111	all	none
1999	57	79	44	180	all	none
2000	726	185	89	1000	999	1
2001 spring	58	155	0	213	212	1
2001 fall	2,236	1,077	340	3,653	all	none
2002 spring	23	162	0	185	184	1
Total to date	3,154	1,751	475	5,380	5377	3


CANADIAN WILDLIFE HEALTH COOPERATIVE
CWD Positives 2000-2018
2000-2016
2017
2018
45% in does, higher in males
RWMZ
SWMZ
0 40 80 160 Kilometers
Map Generated March 28, 2019
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community


CANADIAN WILDLIFE HEALTH COOPERATIVE
CWD Positive Wildlife Management Zones by Year
2018
RWMZ
SWMZ
0 25 50 100 150 Kilometers
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Summary of 2018 Hunter Surveillance CWD Testing.

Species	Inconclusive	Negative	Positive	Total	% Positive
Elk	23	113		136	0
Moose	18	91	2	111	1.8
Mule Deer	8	615	239	862	27.7
White-Tailed Deer	14	962	64	1040	6.2
Grand Total	63	1781	305	2149	14.2

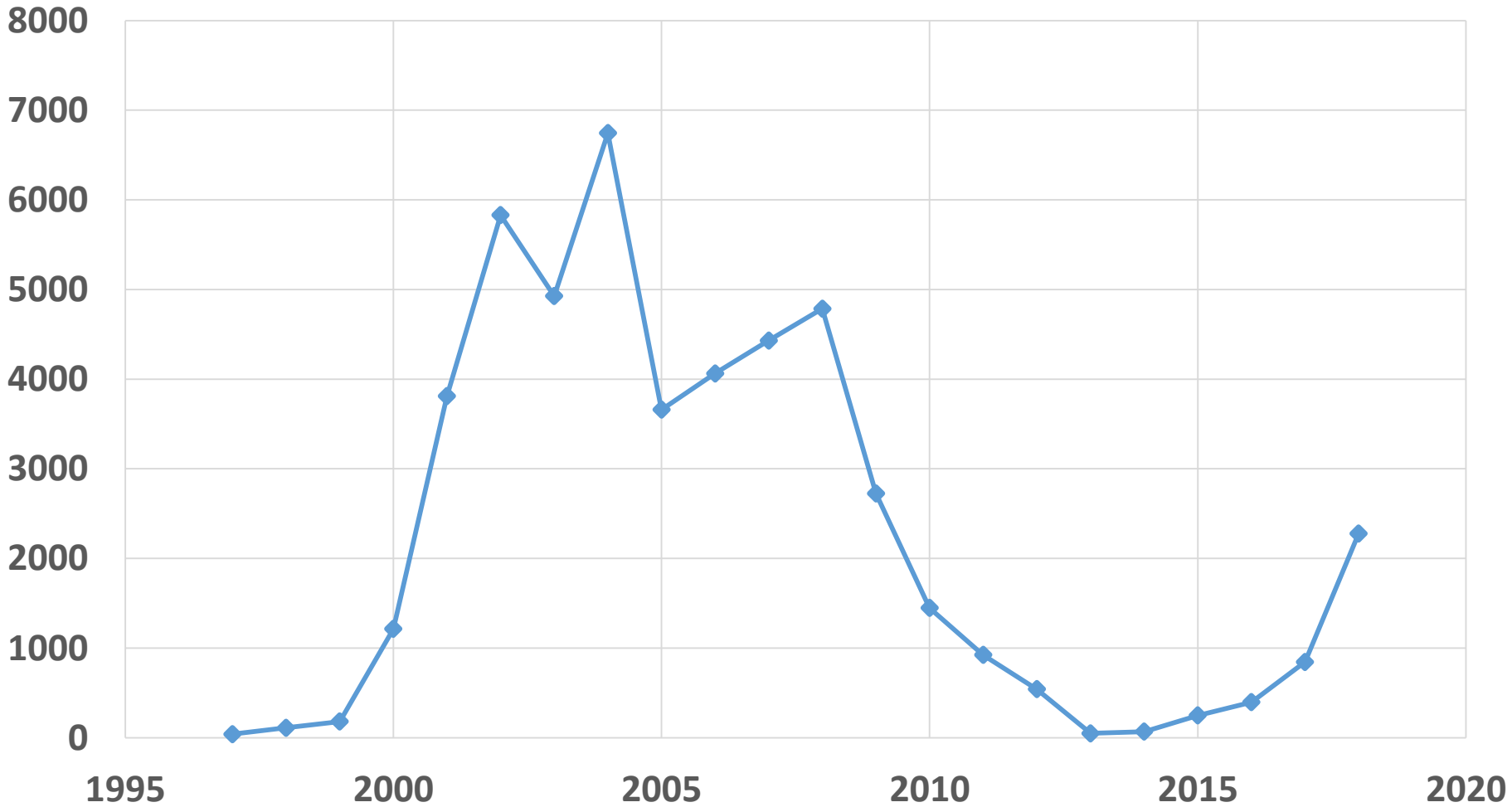
~25% of hunted mule deer

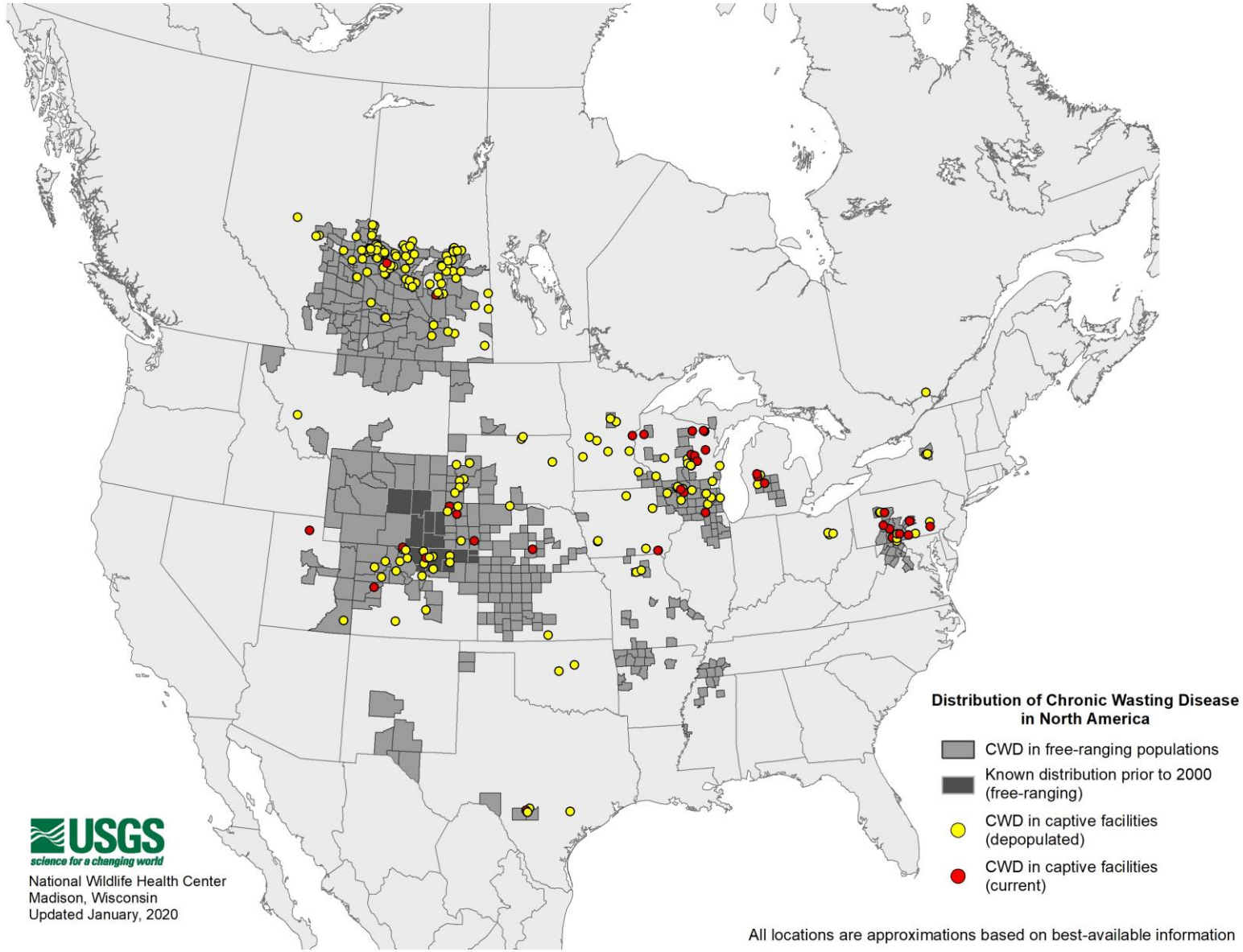
~ 4% of hunted white-tailed deer

Summary of 2018/2019 diagnostic specimens

Species	Inconclusive	Negative	Positive	Total	% Positive
Elk		16	3	19	15.8
Fallow Deer		1		1	0
Moose	5	38		43	0
Mule Deer		47	33	80	41.3
White-Tailed Deer	1	41	14	56	25.0
Grand Total	6	143	50	199	25.1

TOTAL NUMBER OF WILD CERVIDS TESTED BY YEAR IN SASKATCHEWAN





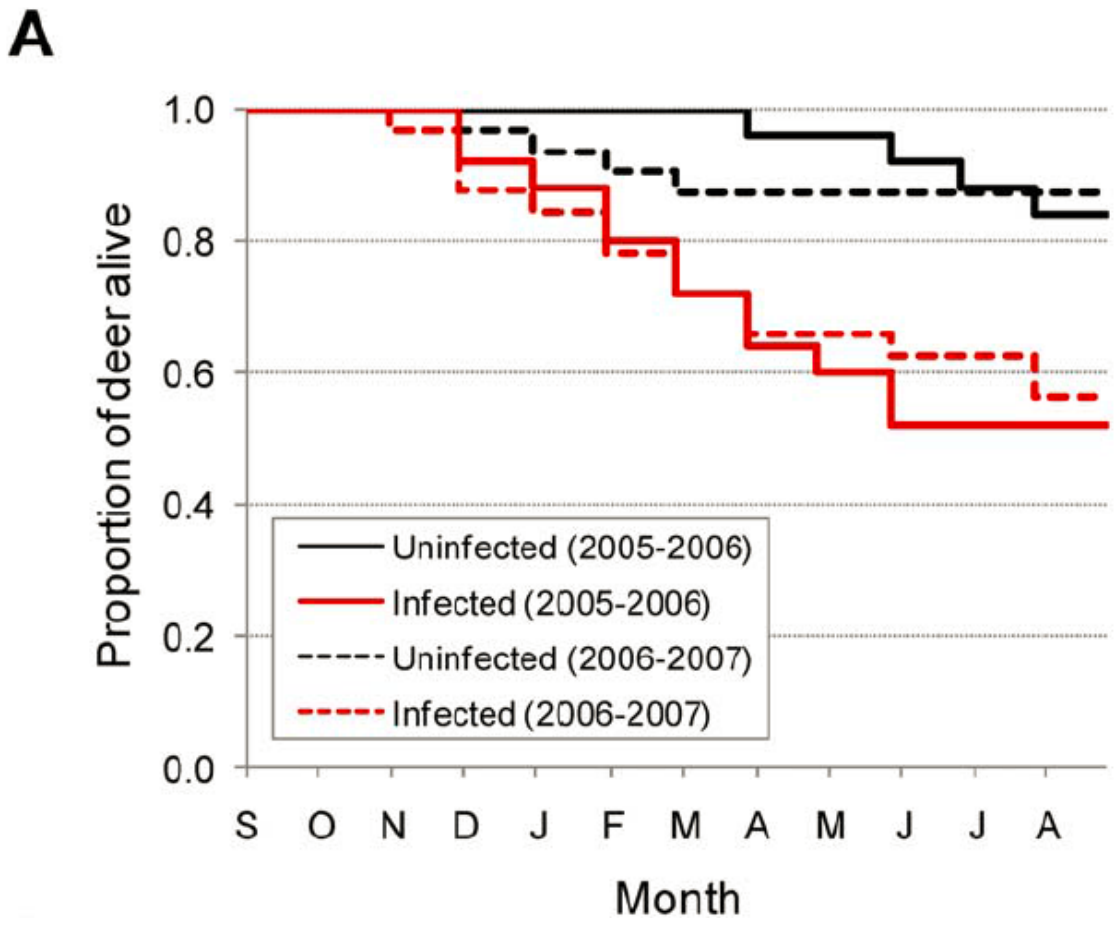
South Korea
Norway
Finland

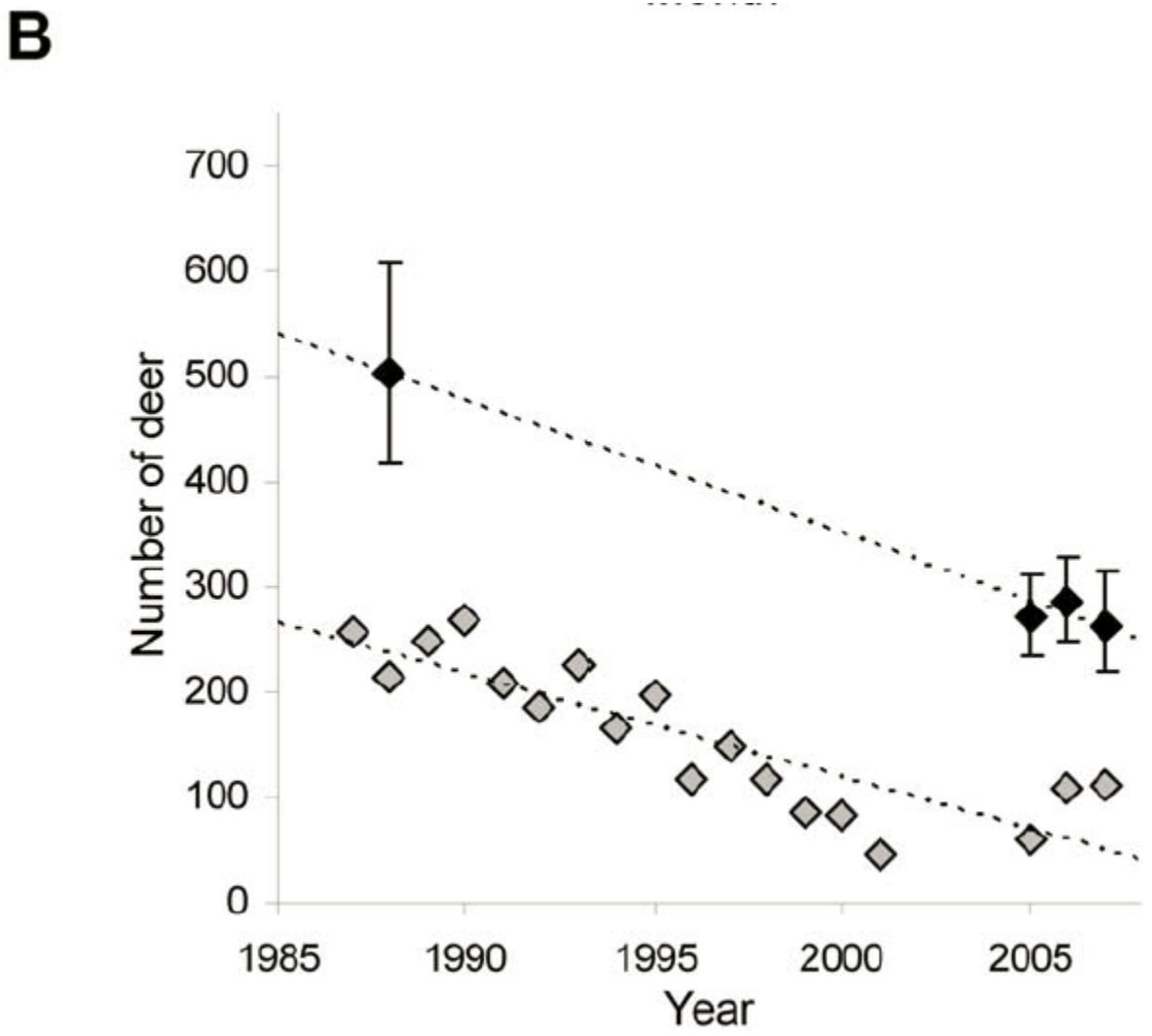
http://www.nwhc.usgs.gov/disease_information/chronic_wasting_disease/

So what: Why manage CWD?

- Human health risk
  - Risk, if it exists, is likely very low
  - If not for BSE in humans causing vCJD, this wouldn't even be an issue
  - Health Agencies don't recommend eating TSE infected animals
- Risk to traditional livestock
  - Risk, is likely very low
  - No evidence of natural transmission of CWD to livestock
- Risk to cervid farming
  - Clear risk of transmission of CWD from wild to domestic cervids
  - Potential to make industry uneconomical
  - Demonstrated risk of game farms introducing CWD to new areas.
- Risks to wild cervids significant

Evidence of CWD impacting wild cervid populations

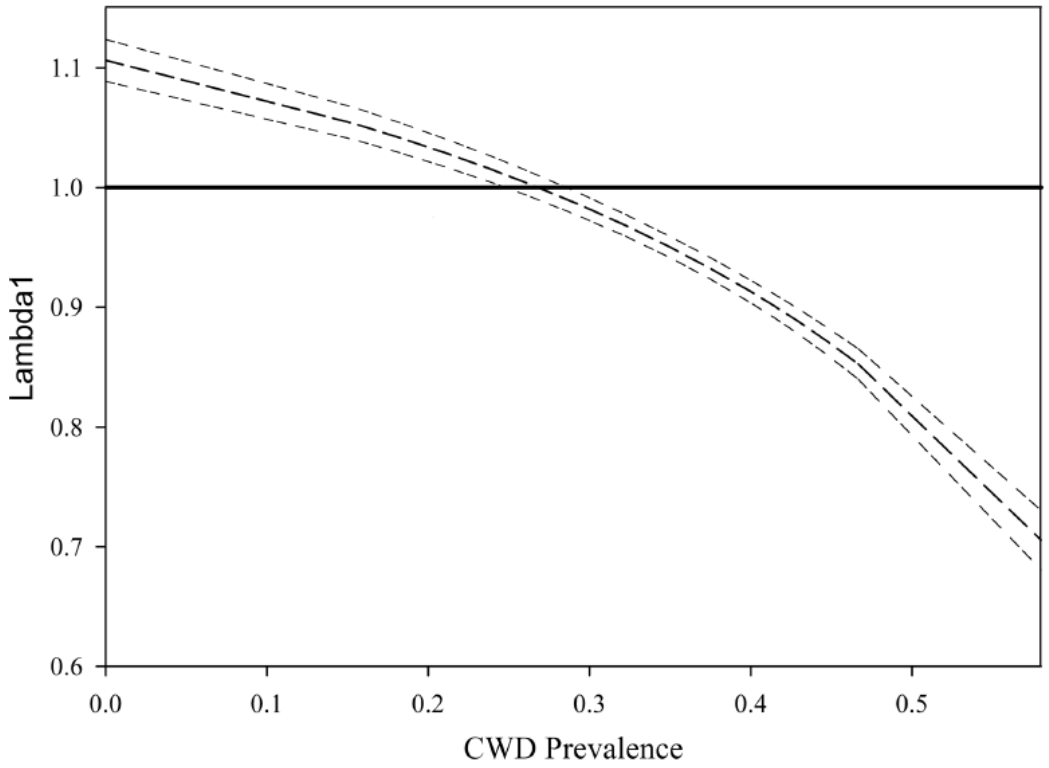




[1]Lions, Prions and Deer Demise. Miller et al., 2008

Evidence of CWD impacting wild cervid populations

- CWD shown to cause population declines in Wyoming mule deer (DeVivo et al, 2017)
  - 43% prevalence in males
  - 18% prevalence in females
- Also caused population declines in Wyoming white-tailed deer (Edmunds et al, 2016)
  - 28.8 % prevalence in males
  - 42% prevalence in females



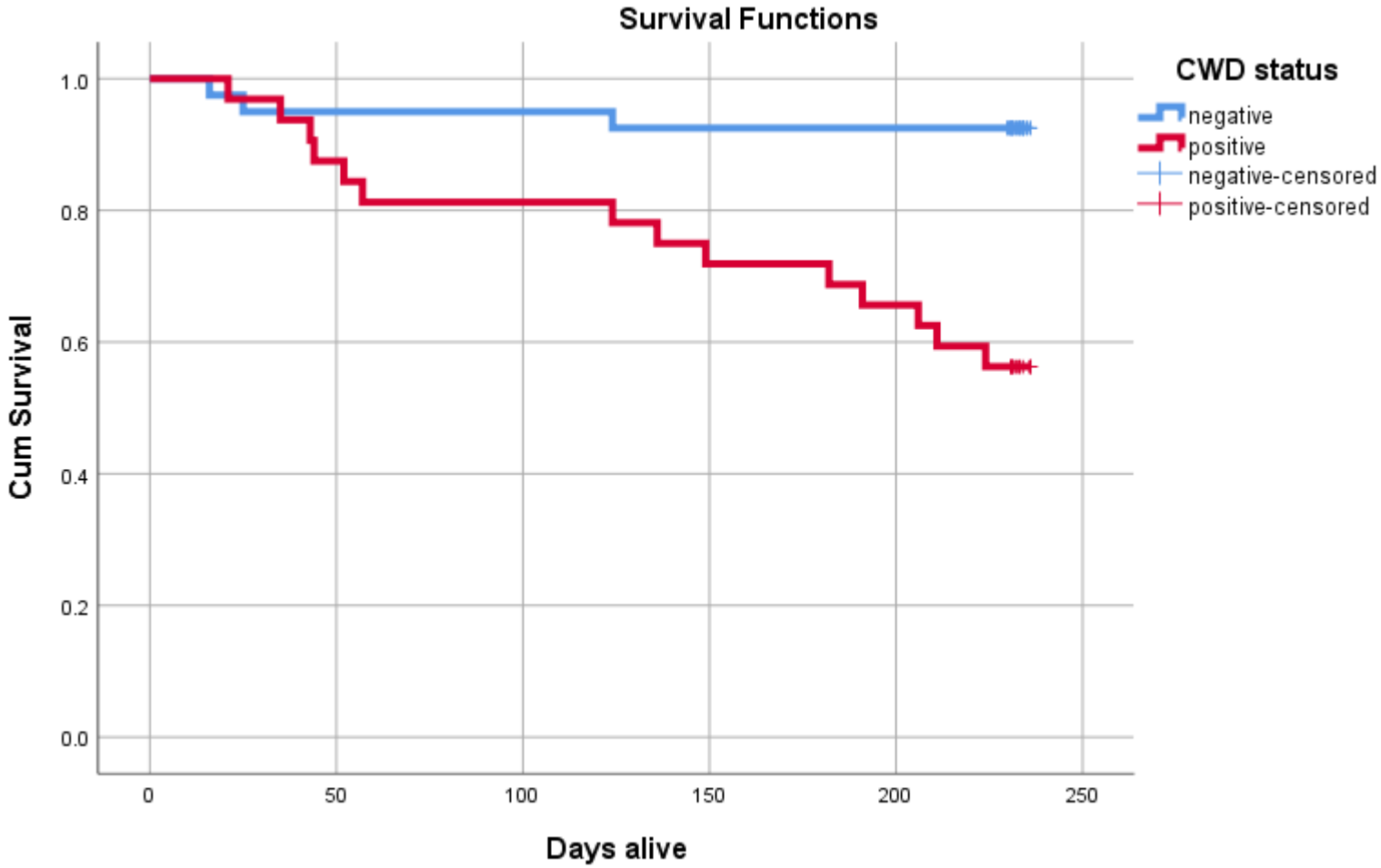
Edmunds et al, 2016)


BIGHORN
C-FYIP

Capture results

Location	Number of deer	Prevalence
Antelope	51	**39 %**
CWD negative	31	
CWD positive	20	
Matador	52	**46 %**
CWD negative	28	
CWD positive	24	
Total	103	**Average 43%**

- Mean age of does:
  - Matador = 3.1 years
  - Antelope = 2.7 years



Preliminary results

17 mortalities

21 censored (8 Pos:13 Neg)

55 known alive (18 Pos:37 Neg)

Table 3.4: Annual (Apr–Mar) survival rates (SE) of adult male and adult female radio-collared mule deer in southern Saskatchewan, 2006–2008.

Sex	2006	2007	2008
Female	0.76 (0.06)	0.72 (0.05)	0.86 (0.08)
Male	-	0.82 (0.05)	0.62 (0.07)

Impact of CWD on wild cervids

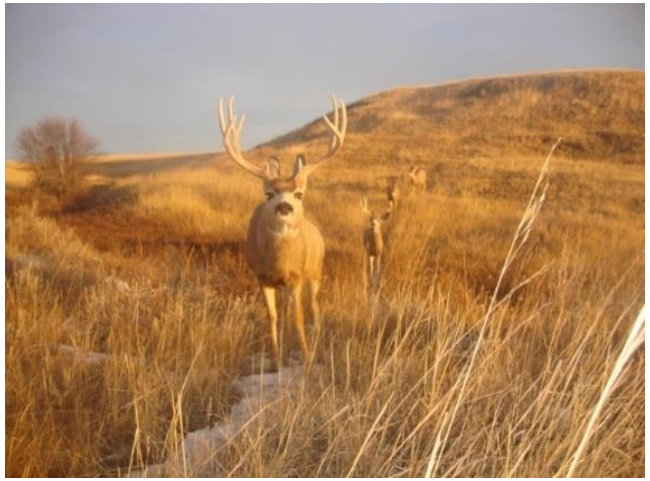
- Declines in wild cervid populations
- Shift to younger age classes
- Altered food webs
- Less hunting opportunities
- Reduced subsistence hunting
- Change in hunting patterns
- Concern over food safety changing cultural practices
- Potential spread to caribou

Currently no effective means to eradicate or manage the disease

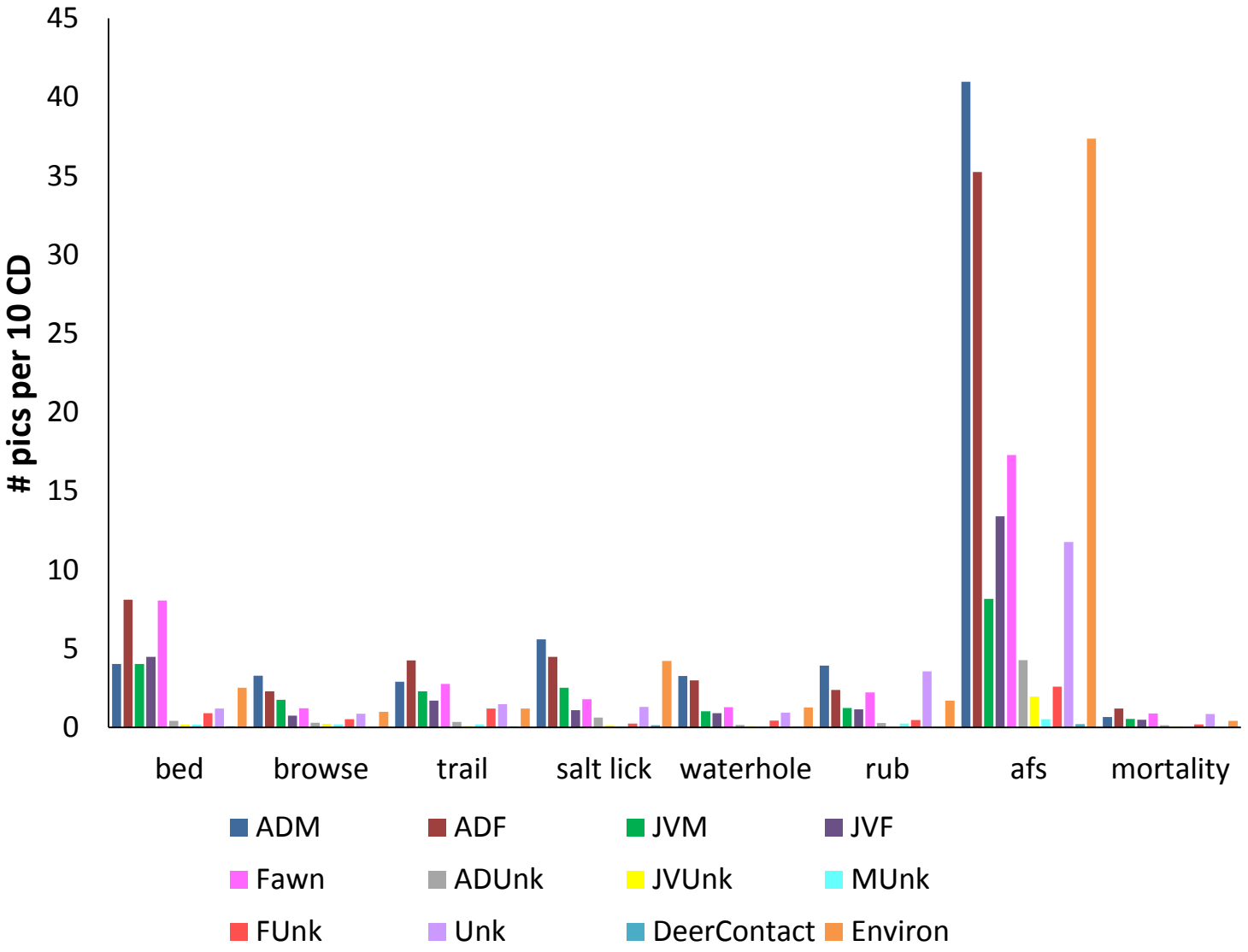
- Proposed options for management
  - General population reduction
  - Selective removal of infected cervids
    - Increase harvest of males
    - Increased harvest of females
    - Increase predator numbers to remove sick individuals
  - Remove or reduce areas where deer congregate and contact environment
    - Grain, hay, salt licks, etc


27 5:30 PM


21 20:02



Pictures with deer by site type and sex/age class




14 6:44 PM


15 8:33PM


15 8:31PM


17 9:06 PM


20 10:41PM

Conclusions

- Alternate food sources most important site for aggregation of cervids and for focal contact with their environment
- Reducing access to alternate food sources (grain piles, hay bales) and “bait sites” has to be part of a multi-pronged approach to CWD control

Salt and hay bait sites, aspen parkland, SK

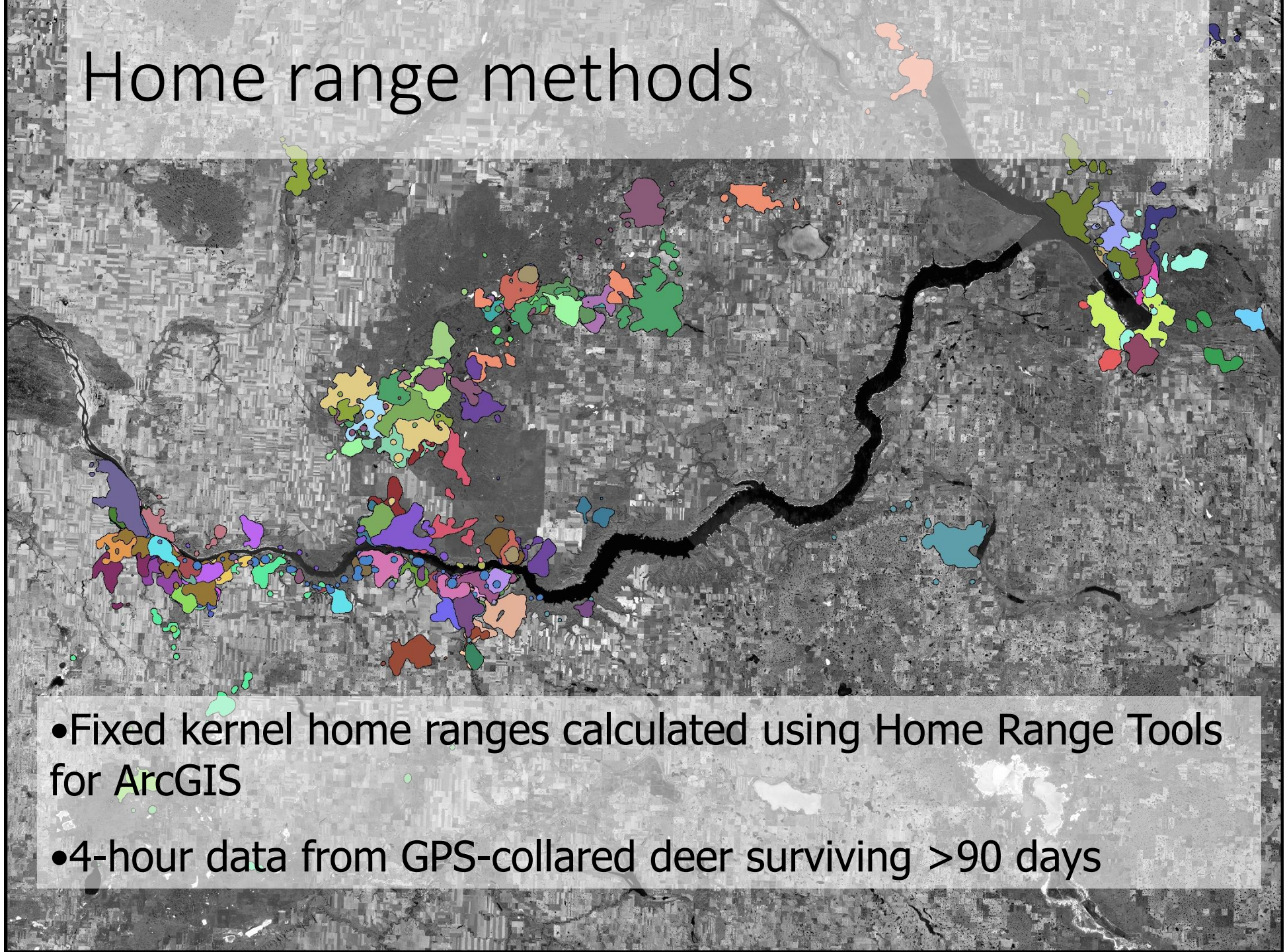
Which management approach to recommend?

- All options are unpopular and often difficult to implement
- Require a long-term commitment
- Often expensive
- Outcome uncertain

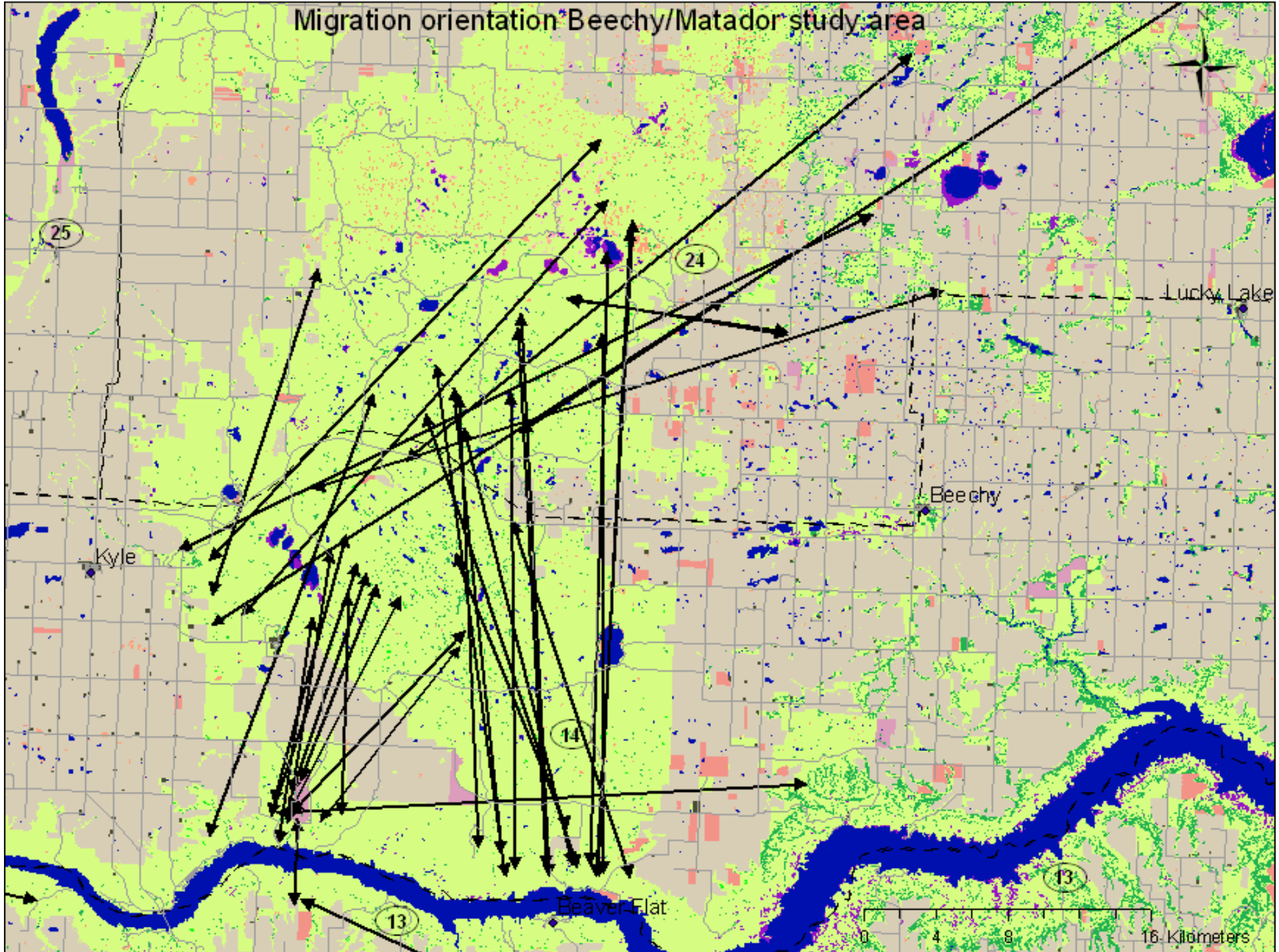
“ Need a multipronged approach to CWD management implemented within a research framework”

http://www.albertaoutdoorsmen.ca/archives/outdoor-pursuits-may-11.html

Home range methods



- Fixed kernel home ranges calculated using Home Range Tools for ArcGIS
- 4-hour data from GPS-collared deer surviving >90 days


Migration orientation Beechy/Matador study area
25
24
Lucky Lake
Beechy
Kyle
14
13
Beaver Flat
13
0
4
8
16 Kilometers

Co-investigators and Collaborators

- Cheryl Waldner
- Nathan Osgood
- Yeen-Ten Hwang
- Evie Merrill
- Ted Leighton
- Dave Coltman
- Margo Pybus
- Maria Mejia-Salazar
- Asha Perera
- Nicole Skelton
- Erin Silbernagel
- Champika Fernando
- Erin Rees
- Catherine Cullingham

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Questions?
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