Chronic Wasting Disease (CWD) 101

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Transmissible Spongiforme Encephalopathy (TSE)

IN HUMANS – Creutzfeldt-Jokab Disease (CJD), Variant CJD (vCJD), and Kuru

- Cattle – BSE, (in Humans vCJD)
- Sheep – Scrapie (not in Humans)
- CWD – some Cervid (deer) species, (not in Humans)
- Other TSE's in other animals such as mink, cats; none transmissible to humans

BSE

- Remains a significant “driving force” behind TSE panic
- Only TSE proven to be Zoonotic
  - Still only small fraction of exposed humans->vCJD
- vCJD-Long Incubation Period
- Age -> Protective Effect

Introduction to Prion Protein

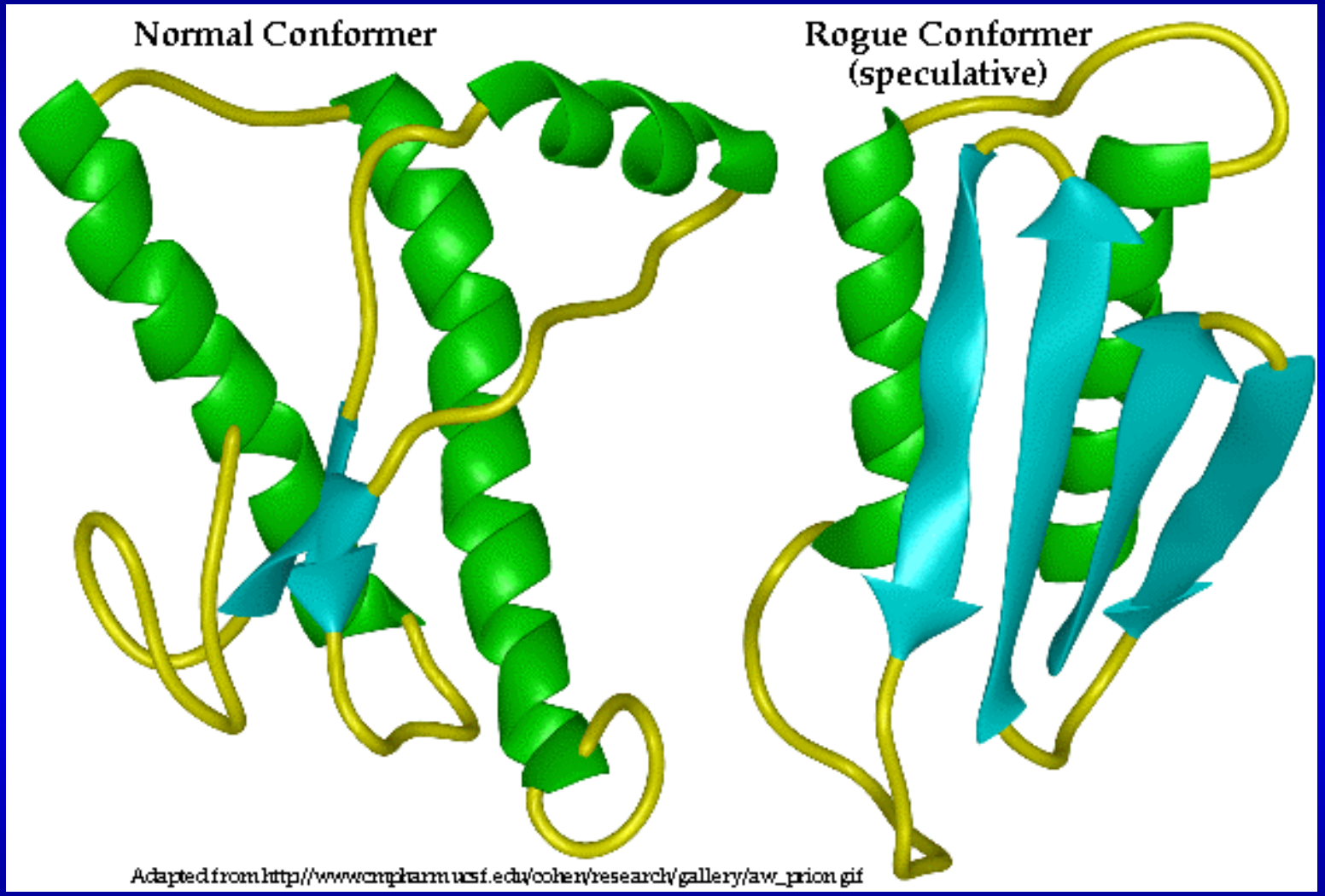
- PrP^{C}: soluble glycoprotein found at the cell surface
- Expressed in most tissues (especially CNS)
- Secondary structure dominated by alpha helices (3)
- Capable of being digested by proteases

Proposed functions of PrP^C

- Copper binding and transport
- Superoxide dismutase activity
- Synaptic homeostasis; neuronal survival
- Cell surface receptor for signal transduction

Infectious Prion Proteins

- PrP^{Sc} (Scrapie Protein), PrP^{Res}; Largely beta sheets
- Conformational change in PrP^{C} gives rise to PrP^{Sc} or PrP^{cwd}
- PrP^{Sc} highly insoluble and protease resistant

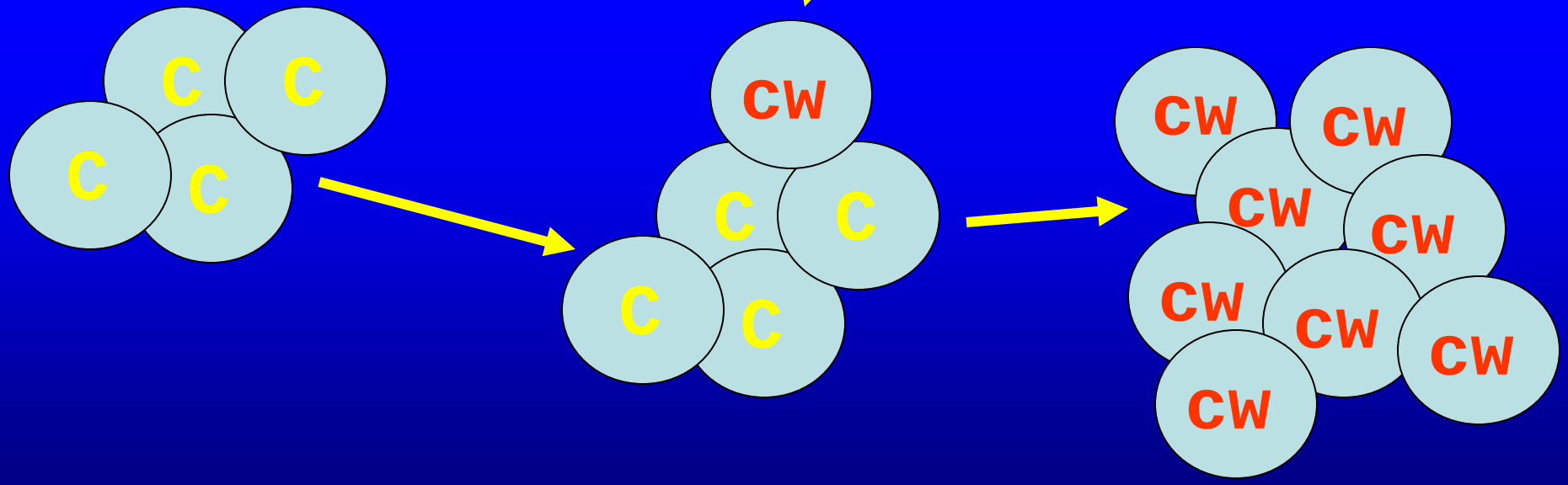

Normal Conformer
Rogue Conformer
(speculative)
Adapted from http://www.cmpharm.ucsf.edu/cohen/research/gallery/aw_prion.gif

CWD: Biochemical Model

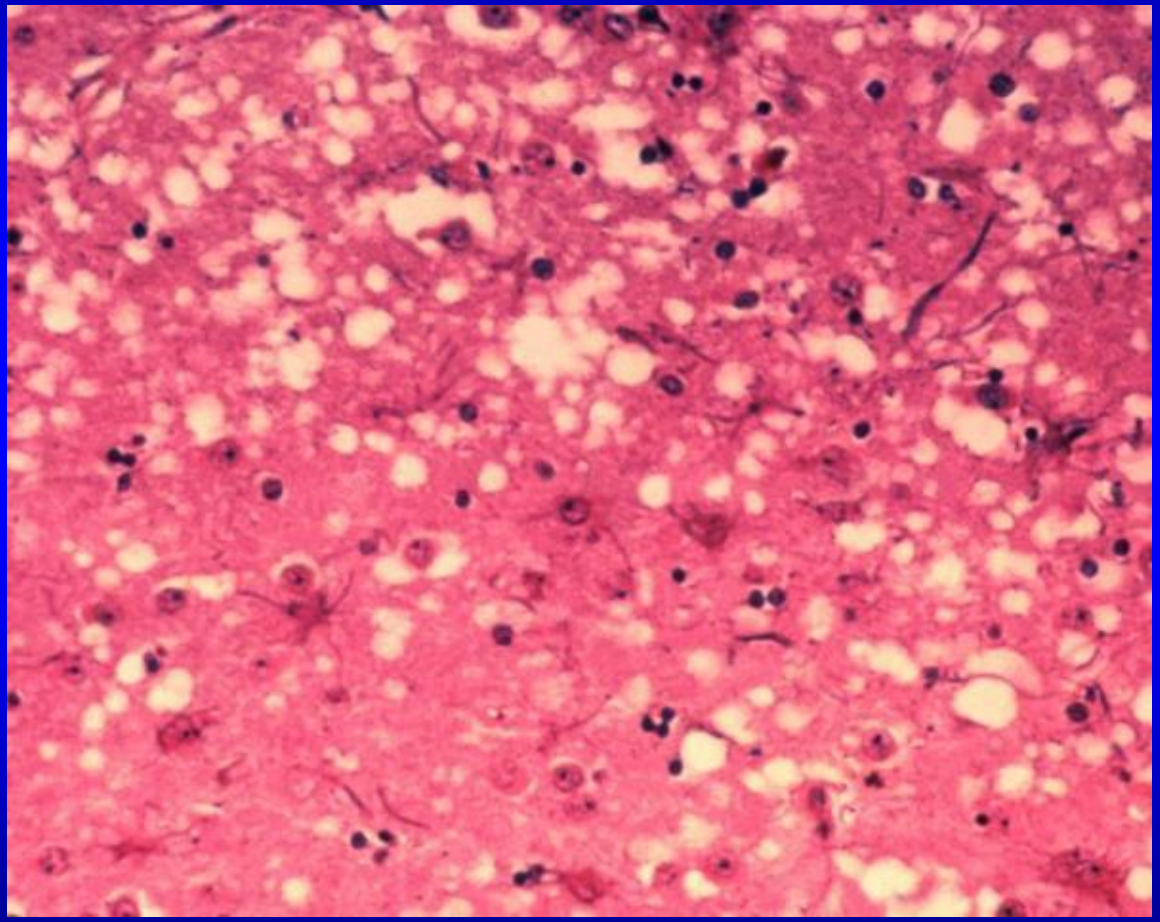
Synthesis of Normal Endogenous Cervid PrP^{C}

Exposure to PrP^{cwd}

Conversion of Normal PrP^{C} to PrP^{cwd}



Spongiform



History of CWD

- First identified in elk of wild origin in the mid 1960's at Colorado State University
- The origin of CWD is unknown
- Hypotheses:
    1. a natural disease of elk and deer
    2. from scrapie infected sheep
    3. deer/elk fed pelleted feed with TSE in it
    4. spontaneous genetic mutation deer prion

Host Distribution

Host Distribution

Host Distribution

Host Distribution

Sika Deer

Red Deer

Clinical Signs of CWD

- Reduced appetite, polydipsia/polyuria
- Loss of body weight (Resultant poor condition)
- May carry head and ears lowered
- Increased salivation→slobbering/drooling
- Incoordination, ataxia, head tremors
- Wide body stance

Typical Elk With CWD

Typical Elk with CWD

Typical Mule Deer With CWD

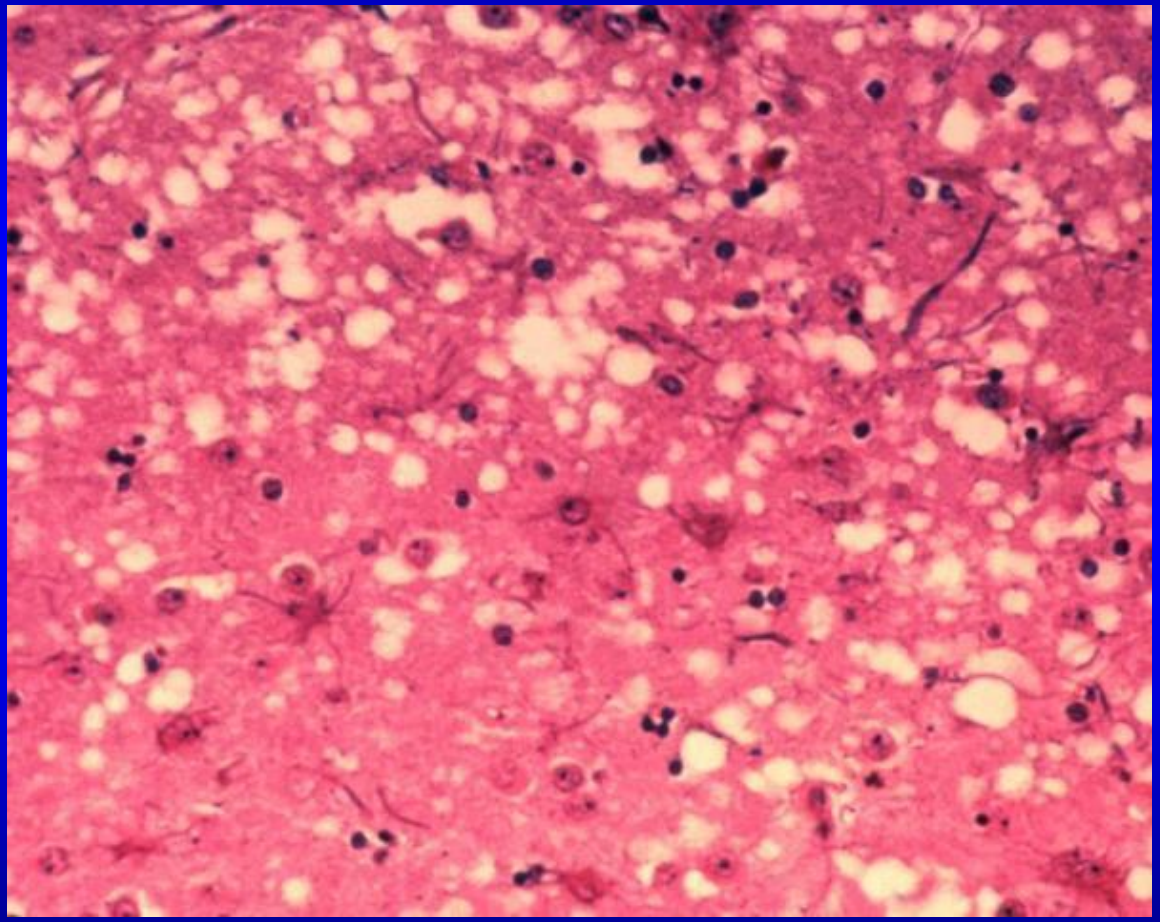
How is CWD transmitted

- **Close contact with infected animals and/or infected food; contaminated environment**
- **CWD prions are shed in saliva, urine and feces**
- **Above, plus infected carcasses (esp CNS) may contaminate environment.**
- **Once contaminated, the environment stays contaminated for years-decades.**

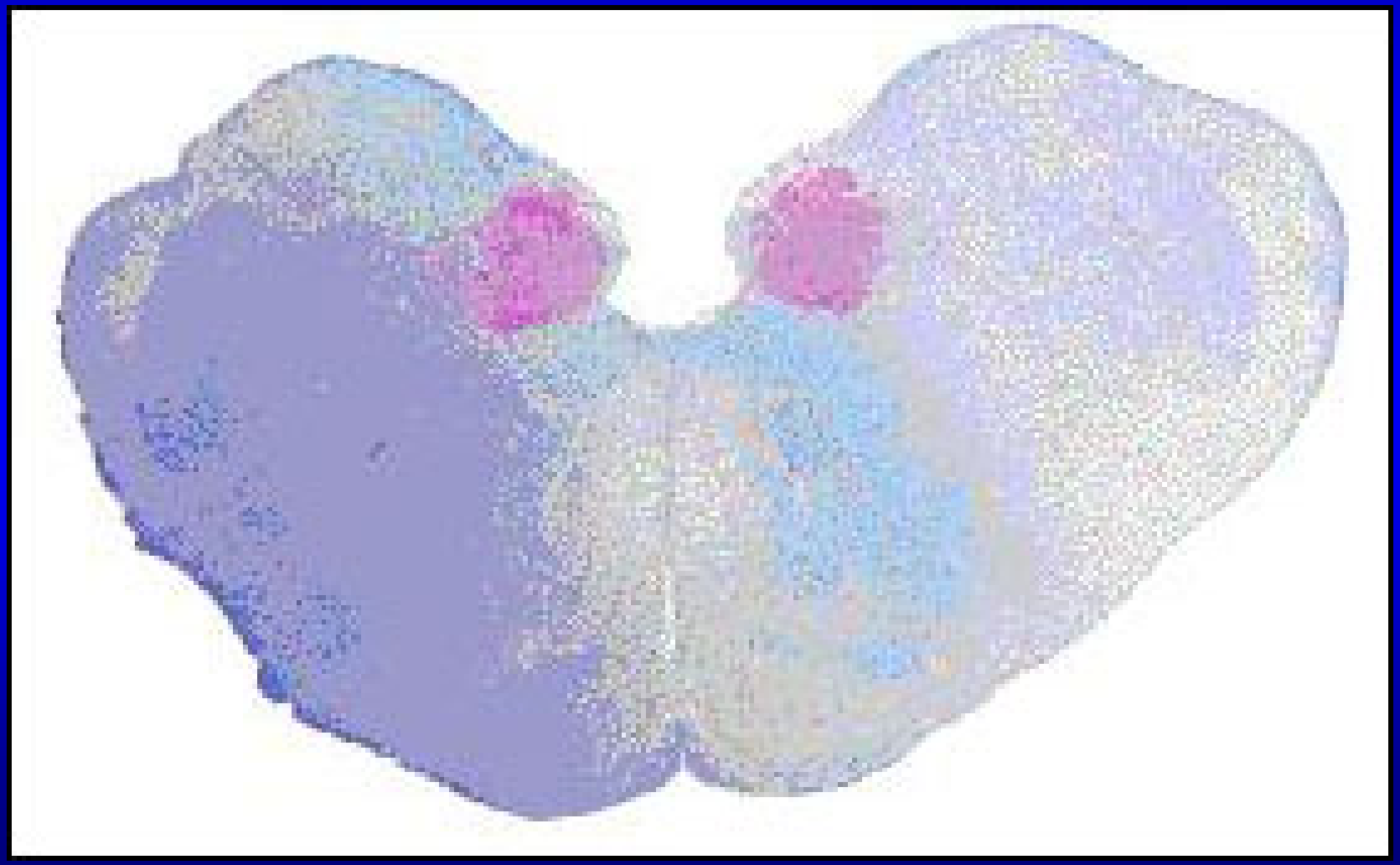
Diagnostic Tests for CWD

- Postmortem: "Gold Standard" is IHC test performed on Obex of brain or "Retro LNs"
- IHC test is an antibody-based staining procedure (presence/absence PrP^{Sc}) which is evaluated using light microscopy
- Other tests: ELISA-based tests (enzyme linked immunosorbent assay)
- Antemortem Test: Tonsillar and rectal biopsy test using IHC technology
- Others in development

Spongiform



Immunohistochemistry (IHC)



Prevention of CWD

- **No Approved Vaccines Available; disease is inevitably fatal to infected cervids**
- **Preventing exposure prevents disease (Importation of cervids from CWD endemic areas)**
  - **Live or dead (CNS)**
- **Can’t stop natural migration**

Genetic Component: Heritable Resistance to CWD

- Naturally occuring genetic variation (PRNP) exists within deer and elk populations that either enhances susceptibility or resistance to CWD

- Natural resistance does not appear to be complete.

Transmissibility of CWD

- **NO evidence of natural transmission to domestic animals or other non-cervid species**

- **CWD can be experimentally transmitted to cattle via intracranial inoculation***

- **CWD can be transmitted to transgenic mice expressing a cervid PRNP gene, but NOT to mice expressing the human PRNP gene**

Transmissibility of CWD to Humans

- **ABSOLUTELY NO EVIDENCE that CWD is transmissible to humans despite the frequent and long term (50+ years) consumption of venison**

- **Transgenic mice "humanized" by insertion and expression of the human prion gene (PRNP) show no evidence of disease following experimental challenge with CWD**

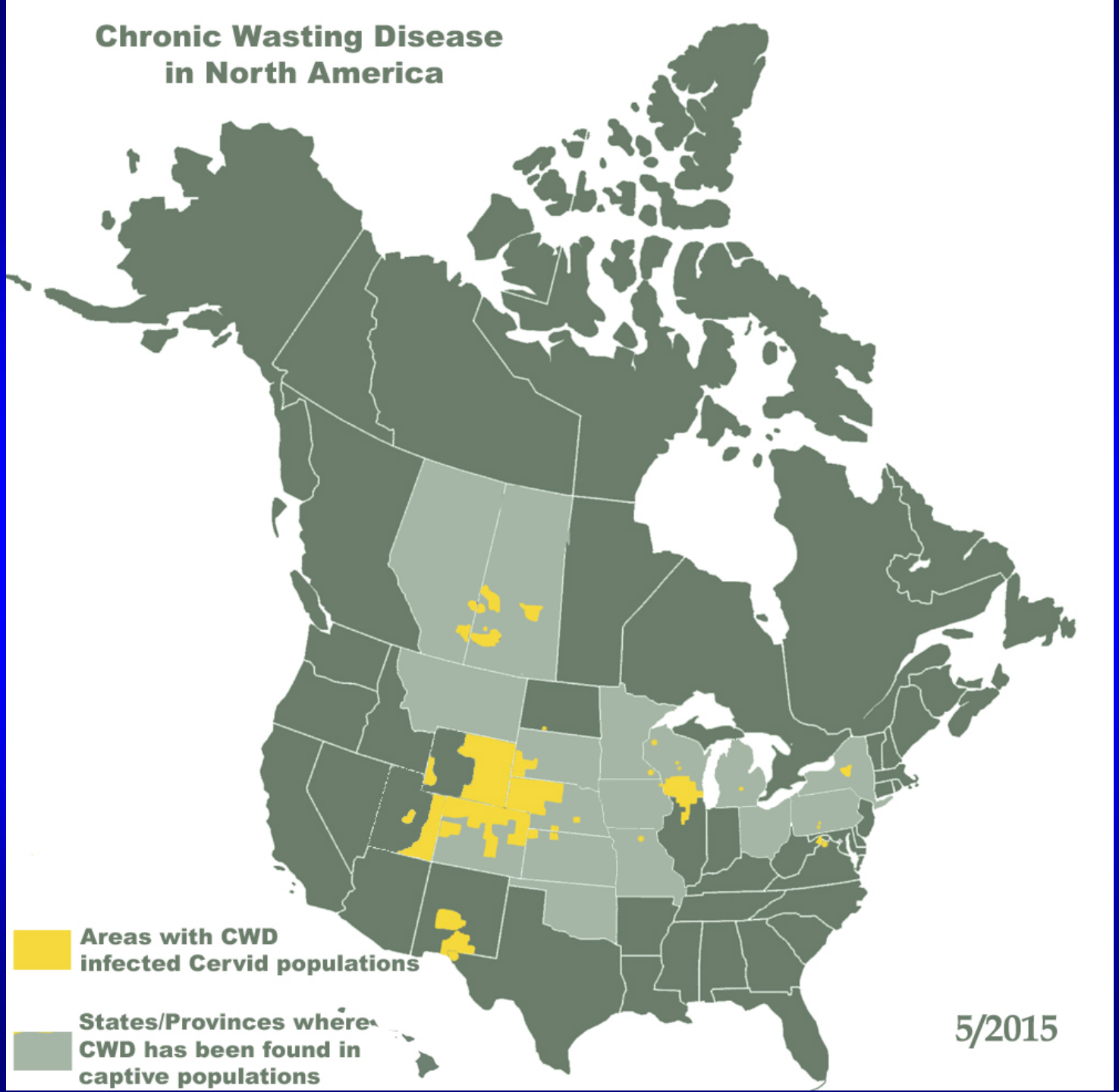
CWD conflict

- WL agencies: meat from harvested game be consumed
- Advise against consuming meat from any “diseased” animal
- -> conflicting message re CWD

Levels of Prions

- Brain>Spinal Cord & some LNs>organs>Heart> Skeletal Muscle

- “Reasonable Precaution”: don’t eat brain, spinal cord or lymph nodes of the head


Chronic Wasting Disease
in North America
Areas with CWD
infected Cervid populations
States/Provinces where
CWD has been found in
captive populations
5/2015

Should we be concerned about CWD?

- Yes! But don't panic!
- No evidence yet that it has widespread impact
- Some local populations -> declines
- Long-term impacts on megapopulations unknown
  - May impact different areas differently

How CWD kills

- Direct mortality
- Indirect mortality
  - Hunters
  - Predators
  - Trauma (HBC)

CWD transmission

- Direct: (animal to animal)
- Indirect: (animal to environment to animal)
- Direct probably more important early, indirect late
- Role of dose

Studies in WY & CO

- Cautionary Tale
- CO & WY probably have had CWD for 20+ years before anywhere else
- MAY indicate what might happen with other populations
- Notably, some populations in CO/WY doing fine w/ CWD
- NOT predictive

Table Mesa, CO Study

- Non-hunted Mule Deer population
- Abundant habitat
- High prevalence (41% males; 20% females)
- 1988-2006 declined 45%
- Due to CWD?

Table Mesa, CO Study

- Used Tonsil Biopsies and Radio Collars to look at Survival
- CWD dramatically reduced Life Expectancy
  - Negative Deer-5.2 years
  - Positive Deer-1.8 years
- Mt. Lion Predation 4 times higher for CWD +

Glenrock, WY study

- Hunted WTD population
- High prevalence (29% males; 42% females)
  - Prevalence increasing
- Well established herd, known for trophy bucks
- Also used tonsil biopsies and radiocollars
  - Only fawns brought into study

Glenrock, WY results

- λ= 0.8960
- 10.4% annual population decline
- **If** nothing changes will go extinct in 48 years
  - Things can change
- Results indicate this is due to CWD

Other interesting Findings

- CWD has biggest impact on 2 year old age class
- Age Structure shifted to younger deer
  - May explain reduction in Trophy Bucks
- No new infections in deer after 6
  - Does age offer a protective effect?

Will CWD impact all cervid populations?

- No evidence of large-scale impacts
- Many variables
  - Animal density
  - Genotypes
  - Species
  - Soil
- No way to predict

How should we manage CWD?

- Don’t panic
- Common-sense: control/contain it
- Recognize it may have population impacts
- Recognize the above will take decades
- Realize more options will become available
- Try to prevent environmental contamination

How to minimize environmental contamination

- No CNS from endemic areas
  - Bone out- or remove brain/spinal cord
- Remove live sources of CWD prion
  - Sacrifice known positives
  - Sacrifice high-risk animals
  - Require sequential live-animal tests on potentially-exposed cervids

I support trying a new approach!

- Let me know how I can assist!
- I recognize that TPWD & TAHC will lead response and I fully support their efforts
- I applaud the TX deer industry for supporting a novel approach, recognizing the risks involved

Questions

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