

# Advancing solutions for sheep infectious disease problems



[https://upload.wikimedia.org/wikipedia/commons/2/2c/Flock\\_of\\_sheep.jpg](https://upload.wikimedia.org/wikipedia/commons/2/2c/Flock_of_sheep.jpg) viewed 01062020

Dr. Stephen White  
Acting Research Leader  
USDA-ARS Animal Disease Research Unit  
Pullman, WA

# Overview

- In each case:
  - Problem
  - Research So Far
  - Future Plans
- Ovine Respiratory Disease, including *Mycoplasma ovipneumoniae* and potential interface with bighorn sheep
- Malignant Catarrhal Fever
- Coxiellosis/Q Fever
- Scrapie
- ADRU solves infectious disease problems for the sheep industry



# Ovine Respiratory Disease

- Disease in domestic sheep
- Bighorn interface
  - Grazing rights threaten long-standing family operations



[https://www.bozemandailychronicle.com/news/wildlife/bighorn-sheep-mingle-with-gardiner-domestic-sheep/article\\_67966a20-5baf-11e3-a220-0019bb2963f4.html](https://www.bozemandailychronicle.com/news/wildlife/bighorn-sheep-mingle-with-gardiner-domestic-sheep/article_67966a20-5baf-11e3-a220-0019bb2963f4.html) viewed 01232020

- Genetics of *M. ovipneumoniae* nasal shedding
- Foundational data for vaccine development
- Genomics of *M. ovipneumoniae* for vaccine development and diagnostic test improvement

# Ovine Respiratory Disease

- Genetics of *M. ovipneumoniae* nasal shedding
- Genome-wide association (GWA)
  - Search up and down each chromosome for major gene(s)
  - Nasal shedding of *M. ovipneumoniae*
  - There are major genes!
- Suggests will be possible to identify genetically low shedders of *M. ovipneumoniae*
- Future work needed to develop and validate DNA tests to identify those animals

# Ovine Respiratory Disease

- Comparative Immunology of Domestic versus Bighorn sheep
- Differential abundance of immune cells (neutrophils; Highland et al 2016)
- Differential abundance of immune molecules on cell surface (Highland et al 2016)
- Differential immune responsiveness on experimental challenge of older animals with *M. ovipneumoniae* (in preparation)

# Ovine Respiratory Disease

- Comparative genomics of *M. ovipneumoniae*
  - Input for vaccine development and improved diagnostic tests
- Future:
  - Comparison of domestic vs bighorn sheep in younger animals
  - Expanded comparative genomics of *M. ovipneumoniae* and related species
  - Leading to vaccine development

# Malignant Catarrhal Fever

- Most sheep carry virus (OvHV-2) that is not harmful to sheep, but can be transmitted to bison or cattle
- Can cause fatal disease in bison or cattle
- Separation distance has been a successful but limited intervention shown by ADRU
- Rare cases of MCF disease in sheep



[https://www.researchgate.net/figure/Malignant-catarrhal-fever-affected-bison-A-corneal-opacity-ocular-and-nasal-discharge\\_fig1\\_23454474](https://www.researchgate.net/figure/Malignant-catarrhal-fever-affected-bison-A-corneal-opacity-ocular-and-nasal-discharge_fig1_23454474) viewed 01232020

# Malignant Catarrhal Fever

- Vaccine development to protect bison or cattle would enable closer housing or possibly co-grazing
- Promising vaccine candidates in testing right now
- Vaccine development expertise add to Mycoplasma/bighorn pneumonia research program moving forward



# Coxiellosis & Q Fever

- Zoonotic – can spread to humans
- Billion organisms per gram of sheep placenta
- Human minimum infectious dose is one organism
- Airborne transmission – many cases where people did not have direct contact with sheep or other ruminant livestock but had Q Fever traced to them
- No vaccine in U.S. – largely because of BSL3 production
- Potential for \$1 Billion outbreak in U.S.



# Coxiellosis & Q Fever

- Vaccine – produce in BSL2 conditions
  - Mouse model of placental shedding currently underway
- Antimicrobial treatment – often opposed for animals, but this is human health risk
  - Meaningful reduction in shedding would help human health (One Health approach)
  - May be some ways to reimagine treatment that dramatically improve results – data coming soon
- Genetics of shedding/transmission

# Scrapie

- U.S. Scrapie Eradication has made great strides
- Export markets remain closed until we get 7 years without a single classical scrapie case
- ADRU has provided:
- First live animal lymphoid testing
- Reagents for diagnostics
- Many genetic insights, including resistant goats (DNA testing now available)



<https://www.iowaagriculture.gov/animalIndustry/scrapieprogram.asp> viewed 01232020

# Scrapie

- Improved diagnostic testing/surveillance
- Basic understanding of protein misfolding as it happens in the cell
  - Especially factors beyond the prion protein itself
  - For example, chaperone proteins that help guide folding
  - May help investigate rare exceptions to resistance
- Maintain research infrastructure for readiness as needs develop

# **2020 USDA-ARS Animal Health National Program**

## **Assessment and Priorities Evaluation Form**

# Purpose

- The purpose of the survey is both retrospective as well as prospective
- It gives the ARS Office of National Programs information that is used to define the next 5-years of Animal Health Research
  - **Retrospective**- Measurement of impact; Did we accomplish what we said we would?
  - **Prospective**- What animal health disease research would have the most impact for your industry? What research should we be doing or continue to do?

# Details

- A link will be shared electronically (target date is February-March pending approvals)
- Targeted towards stakeholders (producers, researchers, veterinarians, government agencies etc.)
- Will remain open until we get over 500 respondents.
- ~15 minutes to complete

# Summary of Proposed Research Areas

- Ovine Respiratory Disease, including potential bighorn pneumonia interface
- Coxiellosis/Q Fever
- Scrapie/TSEs



# Thank You

- American Sheep Industry
- Producers
- ADRU scientists & staff
- Numerous collaborators
- USDA-ARS funding