Mycoplasma ovipneumoniae
Beyond Sheep and Goats

USAHA Sheep, Goat, & Camelid Committee

Kansas City, MO
October 23, 2018

Maggie Highland, DVM, PhD, Dipl. ACVP
Veterinary Medical Officer-Researcher
USDA-ARS Animal Disease Research Unit
Washington Animal Disease Diagnostic Laboratory
Dept. of Microbiology and Pathology
Washington State University
Pullman, WA
**Mycoplasma ovipneumoniae**

- First identified in New Zealand associated with domestic sheep pneumonia in 1972
  

- Disease associated with suboptimal environmental conditions (poor passive transfer/nutrition, environmental stressors, etc.)

- Known to infect sheep and goats; primarily affects young

- Infection → lowered production in lambs
  - reports from New Zealand; not all reports confirm this

- Fastidious organism (need special culture and/or PCR to detect)

- Often referred to by nickname “Movi”
**Mycoplasma ovipneumoniae**

- Pathogenesis
  - Colonizes respiratory epithelium and inhibits mucociliary clearance
  - Little known about virulence/virulence factors

![Diagram of respiratory epithelium with bacteria and dust particles](source-url)
The link between domestic small ruminants and bighorn sheep (in-brief)

• Small domestic ruminants have been implicated as a source of pathogens identified in association with bighorn sheep polymicrobial/multifactorial pneumonia
  o Captive studies & anecdotal field reports
  o Experimental data suggesting bighorn sheep more “sensitive” to agents of pneumonia

• Implementation of absolute separation
  o Loss of public lands grazing
  o Pressures placed on private land owners
Mycoplasma ovipneumoniae

• Discovered in the last decade to be in high association with the complex phenomenon of bighorn sheep pneumonia
  o Impacts adults and lambs, but not always – healthy carriers, as with domestics (infection ≠ disease)
  o “Pasteurellas” and other mixed bacteria found but not as consistently as *M. ovipneumoniae* is reported


• Current proposals to create “*M. ovipneumoniae*-free” domestic small ruminants

• Reported by some to be species specific to members of subfamily Caprinae (goats/sheep/muskox)
Mycoplasma ovipneumoniae
Previous reports in non-Caprinae species

Beira antelope at a wildlife preserve in Qatar (2005-2006)

Cattle in Colorado (2007-2008)
“assumptions about restricted host range of mycoplasmas, based on the host from which they were first or frequently isolated, are usually made in the context of nearly complete absence of representative sampling of the vast majority of potential vertebrate hosts”

Excerpt from textbook:
Mycoplasmas: molecular biology pathogenicity and strategies for control
Chapter: Emerging mycoplasmoses in wildlife
*Mycoplasma* prevalence and surveillance
Determining the true host range

Alaska study – investigating respiratory associated mycoplasmas

- Surveillance of wild and domestic sheep and goats and non-Caprinae species for carrying/shedding *M. ovipneumoniae*
  - Alaska Dept. of Fish and Game
  - State of Alaska Division of Environmental Health – State Veterinarian

- >1000 wildlife animals tested to date (mtn. goat, Dall’s sheep, caribou, moose, muskox, reindeer, wood bison)

Lower 48 states
Sample wild ungulates as samples are available
**Mycoplasma ovipneumoniae**

Non-Caprinae species

Detection to date:

• **White tailed deer**
  – captive and wild upper Midwest

• **Mule deer**
  – zoologic facility in Southwest

• **Caribou**
  – 43 of 590 tested from Alaska

• **Moose**
  – 16 of 500 tested from Alaska

• **American bison**
  – 1 of approximately 20 now tested in West
**Mycoplasma ovipneumoniae**  
Non-Caprinae species

Tested with no detection to date:
- Antelope (~60; Wyoming)
- Elk (~200; Colorado, Idaho)
- Moose (few tested from Northeastern U.S.)
Mycoplasma ovipneumoniae
Non-Caprinae species

Association with respiratory disease in

• White tailed deer in upper Midwest
  o polymicrobial pneumonia (Pasteurellaceae bacteria)

• One caribou calf
  o Found dead; emaciated body condition
  o Pneumonia identified on gross, confirmed on histopathological examination
    • M. ovipneumoniae and two species of Pasteurellaceae
      (Pasteurella multocida, Mannheimia granulomatous)
Publications

[Ahead of print]

Emma R. Rovani, Kimberlee B. Beckmen, Margaret A. Highland. *Mycoplasma ovipneumoniae associated with polymicrobial pneumonia in a free-ranging yearling caribou (Rangifer tarandus tarandus) from Alaska, USA.* [Under peer-review]
Chasing down another mycoplasma
“Mycoplasma-conjunctivae-like” (Mc-l) bacterium

• Nicknamed this only due to it’s similarity to *M. conjunctivae* in the variable region of the 16S rRNA gene
  o False positive with published assays used to identify *M. ovipneumoniae* (PCR and real-time PCR)
  o More similar to *Mycoplasma dispar/bovoculi* in other genome regions

• Currently uncharacterized - working on isolation & sequencing

• Identified in wild and domestic sheep and goats, elk, antelope, American bison, mule deer, white tailed deer, caribou, moose
Testing method

• PCR followed by sequencing
  o McAuliffe, et al. PCR/primers to initially screen for \textit{M. ovipneumoniae} and “Mc-l”

• Detection limitations
  o PCR detects $10^1$
    o Equates to 7,500 to 10,000 (roughly $10^4$) bacteria being picked up on nasal swab sample
Research in Progress

• Improve detection method limits
• Sequence additional regions of each positive sample to determine genotypes (strains)
  o Goats and sheep seem to have species differences in *M. ovipneumoniae* genotypes (and phenotypes)
• Isolate and full length sequence *M. ovipneumoniae* from multiple animals of each species, wild and domestic, for phylogenetic analyses
• Complete surveillance distribution analyses and wildlife/domestic genotype comparisons analysis in AK
• Isolate and characterize “Mc-I”
The foundation of infectious disease

Diseases are not “transmitted”, infectious agents are transmitted
Disease is an outcome of transmission and is dependent on........

[Diagram]

The Beast (sheep/goats)
The Bug (“Movi”)
The Burden (stressors)

Disease
The etiology of pneumonia in lambs is considered to be extremely complex and relates to synergistic effects of both management practices and infectious agents. A wide variety of microorganisms have been recovered from the respiratory tract of pneumonic sheep (Stevenson, 1969) but the etiological significance of many of them is in doubt. Pasteurella sp. and mycoplasmas were the most common organisms isolated from pneumonic as well as normal sheep. Challenge experiments indicated that these organisms alone have limited ability to induce pneumonia and require predisposing factors.
Thanks to.....

ADRU-ARS-USDA and WSU
- David Herndon
- Nicholas Durfee
- Paige Grossman and other WSU students
- Don Knowles

Others: Dr. Lisa Hansen and Dr. Scott Bender
- Dr. Dan Love & Ed Kline (CO Dept. of Ag)
- Dr. Karen Register (NADC, ARS-USDA)
- Dr. Dianne Norden and Dr. Tracy Nichols (USDA-APHIS)
- Multiple ranchers/private land owners
- **Dr. Bob Gerlach** and Dr. Kimberlee Beckmen (Alaska)
- Dr. Brenda Murdoch (UoI); several folks in VT
Contact information:

Maggie Highland, DVM, PhD, Dipl. ACVP
Animal Disease Research Unit, ARS-USDA
Washington State University
Pullman, WA 99164
Maggie.Highland@ARS.USDA.GOV
Phone: 509-335-6327