Packgoats and *Mycoplasma ovipneumoniae* Prevalence Study 2016

North American Packgoat Association Summary of Understanding

Mycoplasma ovipneumoniae, often referred to by the nickname "Movi" (or some variation of that) is the pathogen currently believed to be the most likely primary cause of outbreaks of bighorn sheep pneumonia that have threatened recovery of that species. On November 10, 2015 information was presented at The Technical Packgoat Meeting to NAPgA and the Blue Mountain Forest Plan Revision team in Pendleton, Oregon that goats had a 90% prevalence rate of *M. ovipneumoniae*. In clarifying this information Dr. Tom Besser noted in an email Dec 15, 2015 that this information was obtained from a "report of a large US survey of sheep operations tested for MOVI". Domestic goats are different than domestic sheep and most certainly pack goats are very different from domestic sheep on public lands grazing allotments.

To consider packgoats the same as sheep for purposes of analyzing the risk of disease (pathogen) transmission to bighorn sheep is in error. Packgoat owners train packgoat prospects from a young age. Packgoats are inextricably bonded to their owner, which represents the "alpha goat" in their small herd. The lifestyle and care of a packgoat in herds of 2 to 10 differs greatly from that of a typical herd of domestic sheep or goats which can range in size of hundreds to thousands. Packgoats are seen by their owners as a significant investment in time and resources for 3 or 4 years before they are viable for packing purposes. Throughout a packgoat's life, the packgoat receives routine veterinary care in order to keep the goat healthy and prolong their useful life.

Available literature at the time of this 2015 meeting quoted decades-old science in its discussion of evidence for "disease transmission" from domestic goats to BHS. There was no, and to date remains no, scientific support to implicate packgoats in BHS die-offs. Goats and sheep are different species and the scientific data from captive commingling experiments concerning pathogen (*M. ovipneumoniae* or other historically examined pathogens, such as members of the Pasteurellaceae family of bacteria) transmission to bighorn sheep and subsequent disease is vastly different. The types of *M. ovipneumoniae* carried by domestic sheep differ genetically from those carried by domestic goats (Maksimovic, Cassirer, unpublished data). Goat types or "strains" of *M. ovipneumoniae* have resulted in relatively mild (non-fatal) respiratory illness, dramatically different than the nearly 100% fatality reported from captive commingling with domestic sheep. To group sheep and goats together, and even packgoats and other types of domestic goats, in the discussion of pathogen or disease transmission falsely implicates packgoats in BHS die-off's.

In more recent research by Besser *et al.* (2016), not a single domestic goat or bighorn sheep succumbed to any sort of pneumonia before or after being infected with a "goat type" of *M. ovipneumoniae* and not a single animal died as a result of disease during the study. Domestic goats were not shown to cause deaths of bighorn sheep as a result of pathogen ("disease") transmission, even when the 3 study goats, were inoculated/infected with a "goat type" of *M. ovipneumoniae* and forced to commingle with bighorn sheep for 100 days. All animals in the study, both the domestic goats and bighorn sheep began showing symptoms of respiratory illness, and all of them recovered prior to being euthanized by the researchers. While the publication would imply that "sub-lethal pneumonia" was induced in the bighorn sheep in this study, this is not consistent with the histopathology reports

from lung tissue that was submitted to the Washington Animal Disease Diagnostic Laboratory in Pullman, WA. Those reports indicated that there were minimal to mild changes that are typically seen in small ruminants that are infected with *M. ovipneumoniae* (bronchiolar associated lymphoid tissue (BALT) hyperplasia and hyperplasia of the bronchial/bronchiolar epithelium); but no diagnosis of pneumonia was reported.

NAPgA is the leading organization in making recommendations on how to safely recreate with packgoats around BHS habitat. The complete lack of relevant research regarding *M. ovipneumoniae* prevalence in packgoats lead NAPgA to contact the USDA - Agricultural Research Unit - Animal Disease Research Unit (ARDU) in December of 2015. ADRU and APHIS (Animal and Plant Health Inspection Service) developed a packgoat *M. ovipneumoniae* surveillance research project.

In the spring of 2016 NAPgA recruited packgoat owners to participate in this research project. Consent was obtained from each packgoat owner. The majority of samples were collected by APHIS personnel and the remainder by Margaret Highland, DVM, PhD, Dipl. ACVP. Duplicate swabs were collected by both APHIS personnel and Dr. Highland. One swab was tested in the ADRU-ARS-USDA laboratory and the other was tested in the Washington Animal Disease Laboratory (except for kids <6 months of age and some of the non-packers that were also tested, which were tested only in the USDA-ARS-ADRU laboratory, as a means to save on research funds, since these animals are not used for packing).

A **packgoat owner survey** was completed. Information obtained was as follows:
- Goat information: Age, Sex, Breed
- Number of goats on premises (packers, non-packers)
- Illness(es) within the last year, including pinkeye/respiratory disease
- Any recent (last month) use of antibiotics
- Vaccination and antiparasitic regimen
- Use of packgoats on public lands? Proximity to bighorn sheep?

Samples collected (spring-fall 2016)

Packgoats
- 3+ sets of duplicate nasal swabs collected at 4 week minimum intervals
- 1 blood sample for serum

Other goats (milkers/breeders/etc) on premises
- At a minimum, 1 or 2 nasal swabs collected, at 1 to 3 time points
- Not all premises had “non-packer” goats on premises sampled
- All samples processed within 72 hours of collection

Sample Testing
- Nasal Swab samples tested by PCR and/or qPCR; positive samples confirmed by DNA sequencing
- PCR = polymerase chain reaction = technique that amplifies a segment of the bacteria’s genome to determine if it is present
- Duplicate nasal swabs from the first sample collection submitted to the Washington Animal Disease Diagnostic Laboratory (qPCR analysis)
- Serum samples are currently banked frozen

Distribution

State	#premises	#packgoats	# other goats	Total
AZ	3	16	23	**39**
CA	5	28	31	**59**
CO	8	29	12	**41**
ID	25	115	21	**136**
KS	1	13	51	**64**
MT	5	15	14	**29**
NM	1	2	0	**2**
NV	2	8	0	**8**
OR	9	35	0	**35**
UT	5	36	0	**36**
WA	14	77	5	**82**
WY	5	43	0	**43**
Total	**83**	**419**	**157**	**576**

WADDL Test Results

# Goats Tested	Detected	Indeterminate *	Not Detected
468 (83premises)	18 (5 premises)	20 (9 premises, which overlap with the detected premises)	430 (69 premises)
	3.8% (6.0%premises)	4.3% (10.8%premises)	91.7%

* Indeterminate indicates that either there was an extremely low number of *M. ovipneumoniae* present in the sample OR the sample is truly negative and the low detection is a false positive

WADDL Laboratory Test Results

NAPgA believes the large number of samples tested by the AAVLD accredited state diagnostic laboratory (WADDL) provide sufficient and valid evidence as to the very low prevalence of *M. ovipneumoniae* in packgoats.

ADRU-ARS-USDA Laboratory Results

Since there has been 'concern' by some about using data that has not yet been published in a peer-reviewed venue from this non-accredited laboratory (non-accredited as are the vast majority of federal and state research laboratories) NAPgA will provide reference to the overall packgoat prevalence study including the ADRU-ARS-USDA Laboratory Results in this document.

This is a living document and will be updated as new scientific evidence-based information is available.