



“We bought our 50 purebred sheep at a livestock auction. When we got them home we noticed some of them coughing but, being ignorant about sheep, we thought they just had a cold or were bothered by the dust . . .



“The veterinarian said the older ones were probably getting pneumonia so we gave them all LA200 and it did NOTHING! Then we started to notice that some of the younger ewes in the prime of their lives would get this cough, start to lose weight and then die about a year later . . .



“That’s when we started to get serious about this cough. I searched on the internet and ran across OPP. The listed symptoms explained some of the other things we noticed about these sheep . . .



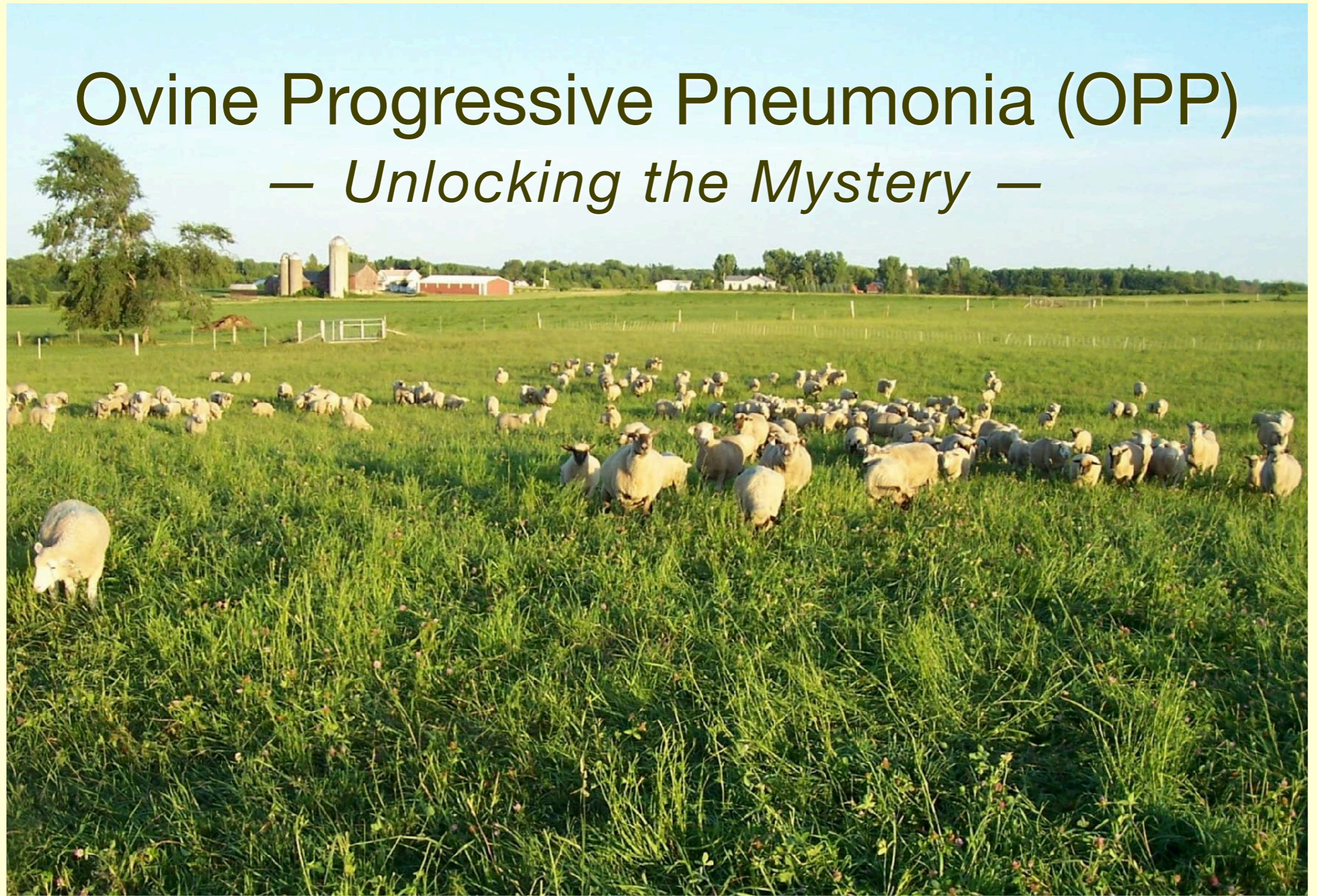
“Like the hard udders – we called them ‘tennis ball udders’ because they would just get a lump but it wasn’t mastitis. Or the way some of them would start to go around in circles, or come up limping, before they began to lose weight . . .



“But the main symptoms were heavy breathing and coughing.”

Ovine Progressive Pneumonia (OPP)

— *Unlocking the Mystery* —



Holly Neaton DVM
Watertown, Minnesota

Basic History of Disease

- Lentivirus recognized in 1915
- Known as OPP in USA, Maedi-Visna (MV) elsewhere in the world
- Maedi (Icelandic for difficult breathing)
- Visna (Icelandic for wasting)
- Several countries are MV-free: Iceland, Australia, New Zealand and Finland

Other Known Lentiviruses (slow)

- **CAE in goats** (caprine arthritis-encephalitis)
- **EIA in horses** (swamp fever)
- **Fe LV in cats** (feline leukemia virus)
- **BIV in cows** (immunodeficiency-like virus)
- **HIV in humans** (human immunodeficiency virus)

Signs of Infection

- Signs rarely seen before 2 years of age
- Chronic unresponsive pneumonia: labored breathing, lagging behind flock, coughing, nasal discharge, can have fever due to secondary bacterial infection
- **Hard udder: udder is symmetrically enlarged and firm yet little or no milk therefore hungry or starving lambs**
- **Some producers report high weaned lamb death losses – poor colostrum from infected dams?**

Signs of Infection, *continued*

- Weight loss despite normal appetite
- Arthritis: swollen hock and knee joints, stiff gait, reluctant to rise
- Unsteady gait, twitching, stumbling, posterior paralysis due to central nervous system involvement
- **Often no signs at all – normal looking sheep**

**Heavy, meaty lungs
from an OPP affected
animal – often seen
with rib indentations**

**See January 1, 2019 JAVMA
p 81 “Pathology in Practice”**



**Knee joint
enlarged
due to OPP
induced
arthritis**



Diseases/Conditions to Rule Out

- Scrapie
- Paratuberculosis (Johne's)
- Parasitism
- Poor teeth
- Bacterial mastitis
- Poor nutrition

NAHMS Report 2001

- Sheep Health Survey by USDA
- 682 flocks tested for OPP infection
- 21,369 sheep (up to 40 ewes per flock)
- 31.5% of producers participating in the survey had never heard of OPP
- 10.9% of surveyed producers were very familiar with OPP
- 1.2% believed their sheep were infected

Results of Survey

- Serum tested for antibodies to OPP virus
- 36.4% of 682 flocks had at least one positive
- 24.2% of sheep tested were positive
- Open range flocks had highest incidence:
80.7% of flocks, 45.1% of sheep
- 33.7% of fenced-range flocks were positive,
but only 14.7% of those sheep were positive
- 36% of farm flocks were positive with 17.1%
of sheep positive

“Iceberg Disease”*

- In many flocks OPP clinical signs are seen occasionally and the disease is thought to be controlled by culling
- As time goes on the flock owner grows accustomed to lowering the average age of ewes – ewes should be productive for 8-10 years. Many infected flocks rarely keep ewes over 4-5 years
- Fewer lambs for marketing as more are needed for replacements

** Term “Iceberg Disease” courtesy of SHAWG.org.UK*

“Economically, OPP is one of the most important diseases affecting sheep in North America.”

**Ellen B Belknap, DVM, MS, Auburn University
Sheep and Goat Medicine, 2002**

“Chronic progressive pneumonia is unquestionably of considerable economic importance.”

**G T Creech, Senior Veterinarian, Pathological Division
Bureau of Animal Industry (USDA, prior to ARS)
Yearbook of Agriculture, 1942**

OPP Controversy

“Serologic survey of prevalence of ovine progressive pneumonia in Idaho range sheep”

JAVMA, December 15, 1978

Many industry leaders who have long denied the economic impact OPP has on the sheep industry have referred to this 40-year-old study of range ewes at the USDA Sheep Experiment Station in Dubois, Idaho. Those researchers reported *no difference in performance between the ~50% infected sheep and non-infected sheep **at the time of weaning . . .***

The Rest of the Story . . .

from two who were working with the flock at that time

Brian Magee

(former Shepherd at Cornell University in New York, retired)

*“They (researchers) failed to note that a **large number of ewes from this flock were culled at lambing with hard udders unable to feed even one lamb.** I don’t have an exact number but it was in the range of 600 ewes both years I was in the lambing barns suckling lambs and taking them off as orphans.”*

Yves Berger

(former Director of the Spooner Dairy Sheep Research Program in Wisconsin, retired)

*“I was working with Brian in Dubois in 1975-1977. My wife was working in the orphan lamb rearing area. The sheer number of lambs raised on milk replacer was certainly a reflection of the poor milking ability of many ewes that numbered about 4,500 at this time. **I was also shocked by the high lamb mortality.**”*

Familiar Story

- Infected flocks often underestimate the problem as they cull the clinicals but never remove the virus. Hence – “Iceberg Disease”
- Those who have recognized OPP as being a major health issue that can be overcome have been ignored and even mocked by the industry, largely due to the Dubois study
- But many progressive shepherds are listening and are eager to eradicate

Producer complaints

- Ewes can't raise twins or even one lamb as they age
- Have full even udder at lambing without a drop of milk
- Obviously high # of orphan lambs to bottle feed, buying too much expensive milk replacer
- High death rate in orphan lamb pens – most likely due to lack of colostrum at birth?
- Ewes fail to bounce back after weaning and wean lower weight lambs

Transmission and Occurrence

- Virus lives in lymphocytes (white blood cells)
- Virus cannot live outside of body for more than a few minutes
- Respiratory secretions and nasal discharge can spread virus (***most important route; 70-90%***)
- Colostrum and milk of infected ewes may pass virus to lambs (***this transmission route is not as important as previously believed; only 10-30%***)
- Shared taggers, needles, tattooing equipment may be another route

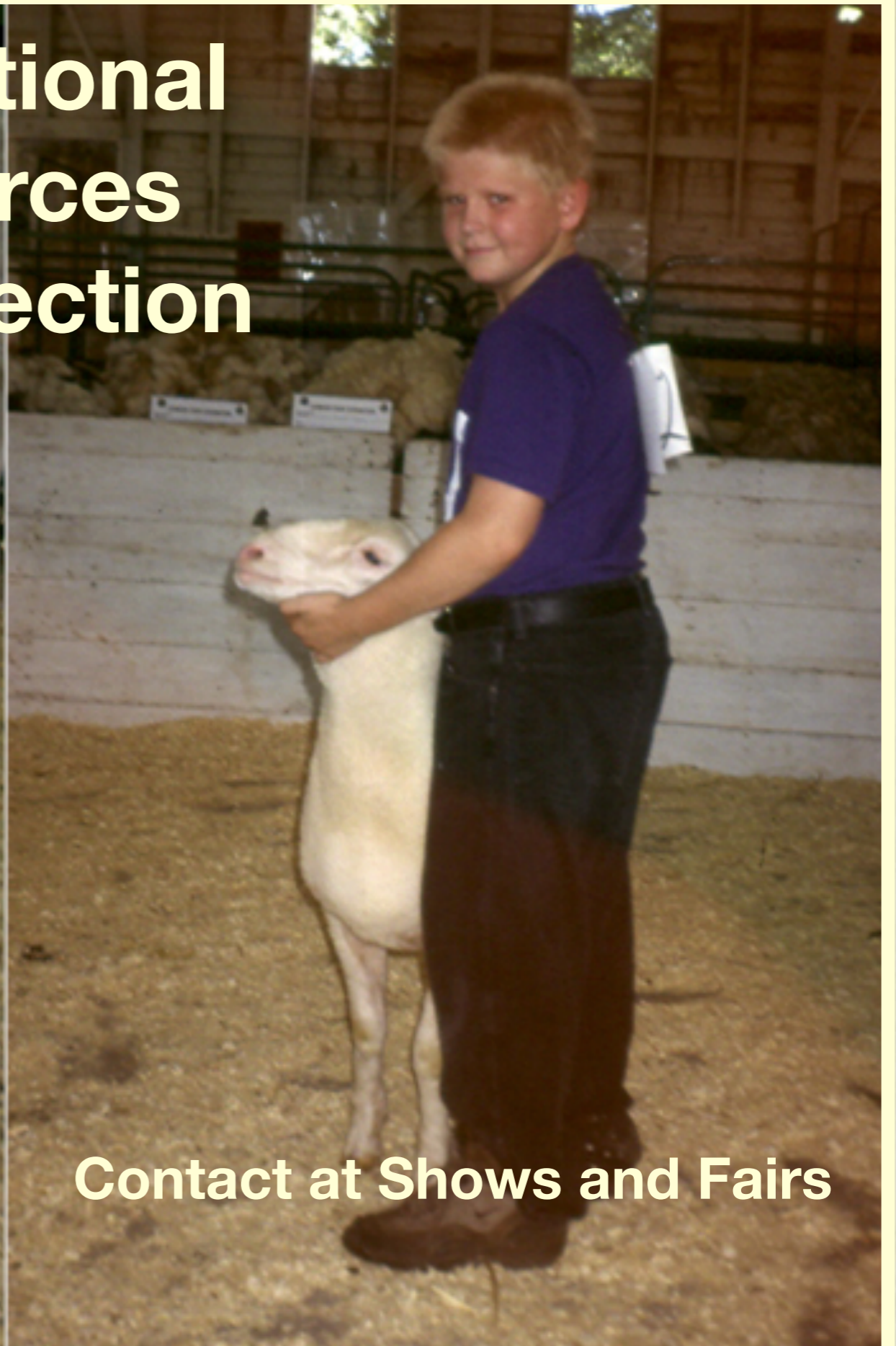
Breed Susceptibility

- Any breed can become infected with OPPv. While some are reported to be more susceptible to infection and development of disease – and others less so – there have not been adequate studies across all breeds to compile a comprehensive list of “most” to “least.”
- In general, Ile de France and Rambouillet may be more effective at controlling OPPv infection, whereas Border Leicester, Corriedale, Dorset, Finnsheep, Finn crosses, North Country Cheviot and Texel are among those breeds more likely to develop disease.
- However, these findings may also relate to differences in viral strains as well as management practices, i.e. may not be solely a function of genotype of the sheep.

Additional Sources of Infection



Goats infected with CAE Virus



Contact at Shows and Fairs

We Have Learned?

- Very prevalent disease
- Incidence of OPP estimated 35 years ago was correct
- Many flock owners are ignorant about OPP
- Do some accept the signs as normal? Would they be amazed at how much more productive their flocks would be without the virus?



**Animals
carrying the
OPP virus often
appear healthy
and free of
infection . . .**



**. . . the only way
to know if they're
infected with
OPPV is to have
them tested.**



Is a Flock Infected?

- History
- Test a few older clinical animals; necropsy
- Test all adults OR a statistically significant portion to determine status: 95% chance of detecting at least one positive animal if at least 5% of the flock is infected. Chart showing how many to test available at OPPsociety.org

Testing for OPP

VMRD cELISA: *tests for antibodies in serum*

- USDA-licensed for both OPP and CAE, the related goat disease, and available at many AAVLD-accredited labs
- Originally developed for CAE testing with a 35% cut-off; later validated for sheep but at a lower cut-off of 20.9% which USDA researchers have used for sheep studies
- However, the cELISA cut-off of 35% is applied for testing of both sheep and goats by all commercial labs, *including those accredited by AAVLD*
- The OPP Society recommends that producers apply the 20.9% cut-off when interpreting cELISA results for sheep

** Note that the former USDA-licensed AGID test is no longer available as the developer and sole supplier of the test kits ceased operation in 2019*

Testing *continued . . .*

Elitest® ELISA: *also tests for antibodies in serum*

- Has picked up positives 2-3 weeks following exposure, with most infections detected within 14-51 days
- Available since 2013 through the University of Minnesota Veterinary Diagnostic Laboratory – ***not USDA licensed**
- Only OPP/CAE ELISA to have been validated according to World Organization for Animal Health (OIE) standards
- Elitest® is used in OPP/CAE test and control programs worldwide, including Canada (Alberta, Ontario, Quebec)

Elitest[®] ELISA

- Each plate has a different cut-off for pos/neg (% of the optical density)
- To compare results from different plates, results are reported as the Signal/Noise (S/N) ratio
- above 1.0 S/N is positive; above 3.5 is positive with greater specificity (between 0.9 and 1.2 considered borderline)
- We have learned to watch for high negatives and either remove them or segregate for retest in 4-6 weeks

Other Diagnostic Tests



- **Post-mortem:** one common and dramatic finding is lung tissue that fails to float in water
- **PCR** (polymerase chain reaction): at ~\$35, a more expensive test and not infallible in recognizing the virus in whole blood

Repeat testing is required!

- One test may tell you if sheep are infected on the day you drew the blood.
- If eradication is the goal, testing of the entire group is necessary multiple times over a 6-12 month period until **at least 2** whole-flock negative tests are achieved.
- This may be an expensive and time consuming venture that needs considerable dedication as leaving even one positive animal in with the flock can lead you right back where you were in a few years and the money would have been wasted.

Genetic Testing for OPP

(TMEM154 tests for susceptibility to infection by OPPv, the OPP virus)

- **2012:** USDA-MARC researchers verified that the *TMEM154* gene affects **susceptibility** to OPPv, favoring “1,1” animals
- **2013:** Rams from **15 flocks** were tested for Minnesota’s Eradication Trial. While **>50% were of the desirable “1,1”** genotype, ***all but two flocks were infected with OPPv***
- **2013:** MARC reported that ***at least one OPPv strain had adapted to infect sheep regardless of their genetic makeup***
- **2014:** During the MN trial, ***two purchased “1,1” rams sero-converted following breeding exposure to test-positive ewes***
- Therefore, while proven to be less susceptible, ***TMEM154 “1,1” and “4,4” animals are NOT resistant to the OPP virus***
- While acknowledging genetic variation, the OPP Society does not recommend genetic testing as a route to eradication. ***However . . .***
- Choosing desirable *TMEM154* haplotypes 1 and 4 may help reduce the incidence of infections in flocks unable to use the test and cull method

Don't forget to test rams! They can also spread the OPP virus



Eradication & Control of OPP

Old School:

- Primary mode of transmission thought to be milk/colostrum from infected dams
- Lambs removed from positive dams and raised as orphans
- Entire flock tested annually; positives culled or segregated; negatives maintained as a separate flock
- Need extra facilities to keep pos/negative flocks separate

New School:

- Only 10-30% of transmission is via milk/colostrum; 70-90% via horizontal contact
- Positive and negative ewes remain together as 'Parent Flock,' nurse lambs to weaning
- Lambs tested 2-3 months post-weaning; negatives are base of new test-negative flock
- More info, including slideshow, at www.OPPsociety.org

Every Flock has Unique Management and Goals

- **Test and cull adults:** If not heavily infected; **still advised to test every 2-3 months until 2 whole-flock negative tests achieved
- **Test replacement lambs at weaning:** Separate positives and retest to determine if maternal antibodies are the cause
- **Facilities** are usually the deciding factor – need distance (min. 10 ft) or solid barrier/electric fence

Frequently Asked Questions

“Where is the best place to send my samples for OPP testing?”

Since many states do not have an AAVLD accredited laboratory, suggested regional labs are noted below. For a complete list, see aavld.org

University of California-Davis
530-752-8709
cahfs.vetmed.ucdavis.edu

Colorado State University
970-297-4109
csu-cvmb.colostate.edu/vdl
**PCR test available

Iowa State University
515-294-1950
vdpam.iastate.edu

University of Minnesota
612-624-0497
vdl.umn.edu
**Elitest ELISA available

Cornell University
607-253-3900
diaglab.vet.cornell.edu

South Dakota State University
605-688-5171
sdstate.edu/adrdl

University of Wisconsin, Barron
715-637-3151
wvdl.wisc.edu

Texas A&M University
979-845-3414
tvmdl.tamu.edu

North Dakota State University
701-231-8307
vdl.ndsu.edu
**PCR test available

Washington State University
509-335-9696
waddl.vetmed.wsu.edu

Submitting Samples

Be kind to your VDL:

- Call ahead with a heads-up as to # and source when multiple samples are submitted
- Can ship priority U.S. Mail on ice packs
- Label appropriately, legibly and keep tubes in order
- Use recommended collection tubes: either **serum separator tubes** (need to be centrifuged); or submit **only serum** poured off from red-top clot tubes

Can I draw the blood myself?

For flock owners who may not have a cooperative DVM available, OPPsociety.org offers a video to assist in sample collection

Producers' Experience

- **195 crossbred ewes:** *“We used testing and culling to rid the flock of OPP — 100% negative in 12/02 and 4/03. Will continue to test every other year and all new sheep that enter. We are very glad that we are OPP negative. Lambing is now a total joy!”*
- **Negative ewes weaned an average of 14# more lambs**
- **70 crossbred ewes:** *“Life without OPP is good!”*
- **750 crossbred ewes:** *“Used whole-flock test and culling to achieve 100% negative status. Have seen all around improvement in flock health.”*

Why Eradicate OPP?

- Allow sheep to perform to their full potential
- Increased value for sales of breeding stock
- Save on feed costs
- Underlying diseases may also be eliminated



Disease-free animals live longer and are more profitable



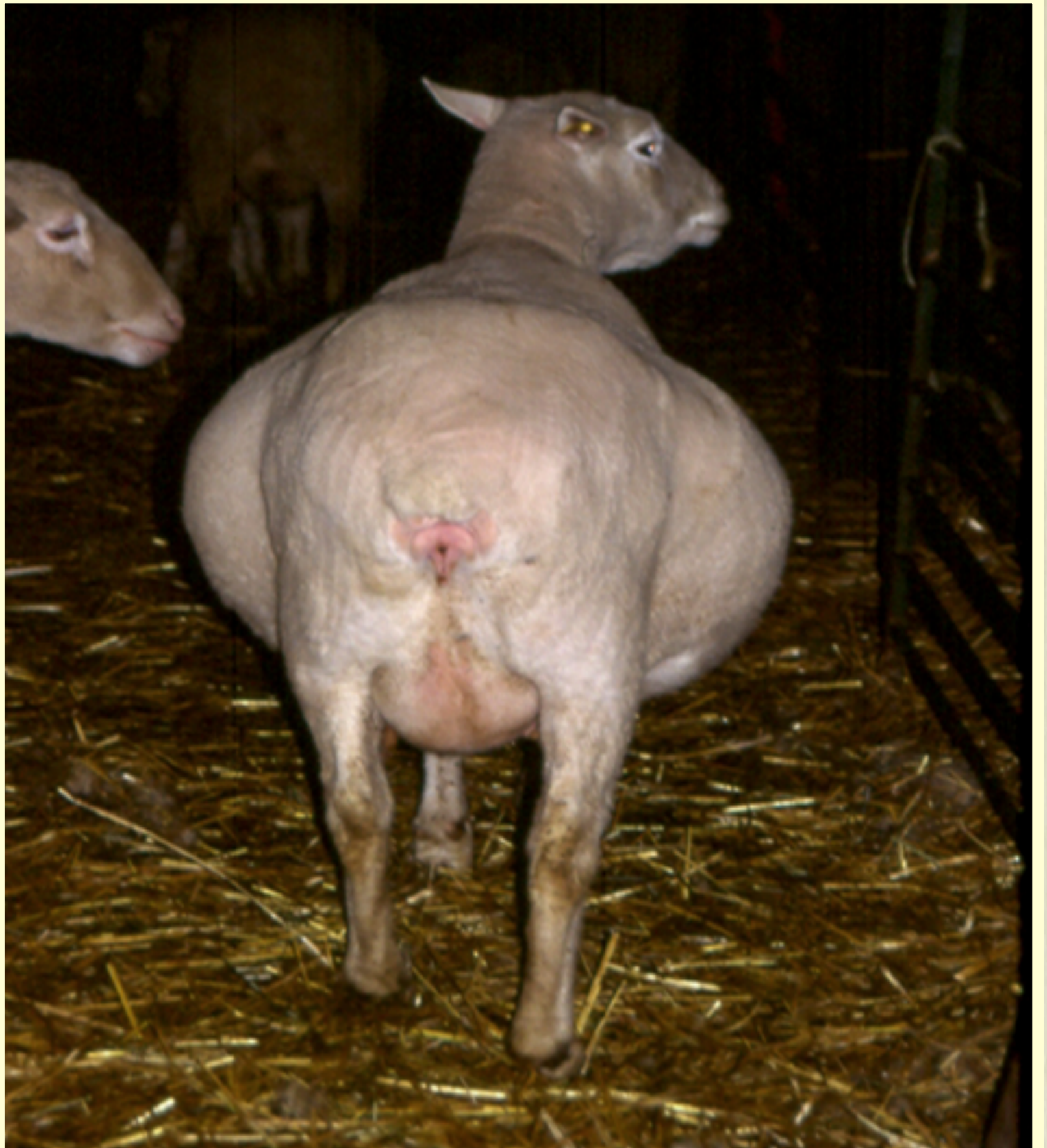
Educational Resource

- **OPP Concerned Sheep Breeders Society**
OPPsociety.org
- Producer organization formed in 1990 when a group of frustrated shepherds wanted more information and understanding of the disease they were trying to eradicate from their flocks
- Members in **26 states + Alberta and Ontario**, flocks number <12 sheep to > 4,000
- **All breeds, commercial and purebred**

OPP Society, *continued*

- Members tend to be interested in eradicating all infectious diseases from their flocks
- Online directory helps locate sheep for sale, assist in veterinarian/producer contacts
- Online video demonstrates blood collection and handling with veterinarian cooperation
- More information and a version of this powerpoint can be seen at: OPPsociety.org

**Eliminating
OPP will allow
productive
ewes to reach
their full
potential . . .**





*... with plenty of
milk for all!*

Resource and Available Programs

- Minnesota's OPP Eradication Trial 2013-2017 (thanks to MLWP, UMN-VDL, MN-BAH, USDA, Minnesota Grown, OPP Society) Full report published and available on OPPsociety.org
- Minnesota's 'Healthy Sheep and Goats' Program is administered through the Board of Animal Health. Run as a pilot by OPP Society volunteers since 2006, the project achieved full program status in 2019. See 'Library' page on OPP Society website for info.

OPP Concerned Sheep Breeders Society

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