

## Rationale for Study

- Farming sheep in the Northeast
  - Small, diverse farms; wet conditions
- Footrot in sheep
  - Predisposing factors
  - Bacterial etiologies: *D. nodosus* (virulent strains)
  - Classification of lesions based on keratinase activity
- Available methods for control
  - Antibiotics: tetracyclines, pen/strep, gamithromycin
    - Extra-label use, resistance
  - Vaccination: Foot Vax
    - Local reactions, efficacy
  - Footbaths +/- trimming
  - Pasture rotation



## Eliminating the Effects of Footrot on Sheep Flocks in the Northeastern United States

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(\*Emeritus)

*D. nodosus* invades deeply



Chronic Carriers: Cull

- Even after trimming, hooves will be deformed



## Design

- Preliminary survey identified foot problems as a major concern
- Primarily a proof of concept
  - Extension: outreach and education
  - Sustainable Agriculture Research and Education
- Goals:
  - Educate farmers regarding foot care techniques
  - Guide development of biosecurity plans
    - Pathogen introduction and re-introduction
    - Comingling species elevates risk
  - Explore genetic differences related to susceptibility
  - 150 farmers will reduce footrot losses by 70% and will have farm biosecurity plans



## Methods

- Farmer survey
- Farm visits
  - Biosecurity discussions/feedback
  - Demonstration of trimming and scoring feet
  - Assistance for farms with limited facilities/staff
- Blood collection at first or second visit: LTT, RTT
  - Serum banked
  - DNA extracted from a subset of plasma samples to establish correlation with susceptibility to footrot (WSU)



## Methods

- Sheep treatment
  - Trim feet and score: 0-5; 0-3
  - Foot dip in 10% zinc sulfide: >10 minutes
  - Sort into “clean” and “dirty” groups
    - Mark chronic cases and cull
  - Dry clean area: >1 hour
  - Move clean or dirty flocks into separate, clean pastures (rested for >2 wks)
  - Repeat weekly for 1 month



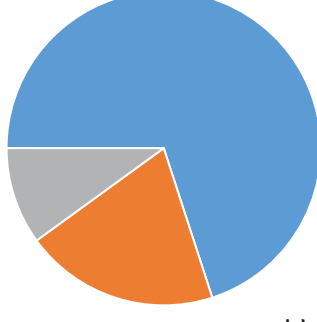
## Foot Bath

- 10% Zinc sulfate solution:
- 8.5 pounds zinc sulfate
  - 10 gallons of water
  - 1 cup of laundry detergent
- Mix well; add waste wool to footbath to improve footing and reduce splashing
- Winter: dry foot bath
- Most farm visits during warm weather in this study



## Results

- 22 farms participated
  - Approximately 1300 sheep
- 60-70% of farms footrot-free by end-of-study survey
  - Failures: why?
    - Not willing to cull
    - "Not enough proactive attention to animals' feet on an ongoing basis..."
    - Got footrot after the end of the project
    - "I don't know."
- 1 of 22 farms did not benefit
- 1 of 22 farms repeated the program; persistent footrot



■ Clean ■ Still affected ■ Not sure

## Footrot Genetics Project

Of approximately 1300 samples sent to WSU, genomic DNA evaluated in 85 (56 Katahdin, 21 Merino, 1 Tuni, and 7 “unknown breed”)

Classified into one of three groups:

- Footrot-free (n=28)
- Mild footrot (n=31)
- Severe footrot (n=26)



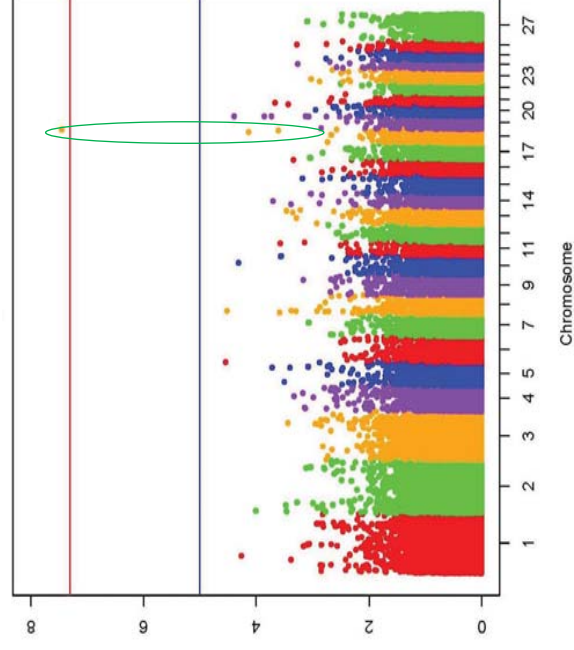
Genotyped using the Illumina Ovine 50K BeadChip

Case-control matching accounted for farm, breed, sex, and age

Linear regression analysis (PLINK) with a genome-wide significance threshold of  $5 \times 10^{-8}$

Reanalysis with higher density chip suggests more markers: data still being analyzed.

## Genome-wide significant SNP (ovine chromosome 18)



## Results

- **Typical responses:**
  - Benefitted from learning techniques (trimming, footbathing, record keeping, other)
  - Financial benefit: modest (\$0 to \$5000/yr)
  - “We learned precisely what had to be done. What we didn't learn was how to make the farm manager keep his team doing it!”
  - “The sheep foot health project has made the difference between us getting out of the sheep business and continuing and now growing the flock.”
- **Biggest barriers:**
  - Culling
  - Separating sheep and keeping fencing intact
  - “Footrot is eradicated by culling, not curing, affected sheep.” (Joe Snyder DVM, AASRP)



## Conclusions

- OAR18 region under investigation for gene content and potential functional variants
  - Possible genetic screening test for footrot resistance
- Producers are interested in this project
  - Webinars: >1000 views
  - Foot-trimming videos: >70,000 views
  - Webpage for project: >17,000 views
- Outcomes and projects
  - <http://umaine.edu/sheep/>
    - >18,000 visits; >70,000 views of video
  - Foot scoring card
  - Expansion of genetic results



## Conclusions

- Reasons for failures:
  - Resistance to culling
  - Inability to reliably separate sheep
  - Limited pasture space or fencing configurations
  - Re-contamination via common pathways
- This method does not work for everyone.
  - Organic growers may adopt
  - Modified method with antibiotic use
  - This method **requires:**
    - Good organization
    - Good fencing
    - Hard work
    - Culling some animals
  - This method **avoids:**
    - Antibiotic costs and development of resistance
    - Vaccination costs and reactions





## Acknowledgements

- Participating farmers
- Susan Schoenian, Maryland
- Staff: Ann Bryant
- Students:  
Nirajan Adhikari, Elaine Bernier, Casey Athanas,  
Katrina Glaude, Kayla Porcelli, Caitlin Minutolo
- Funding: NE SARE, Maine Agricultural Experiment  
Station, ASI (via Noelle Cockett)



## References

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- White SN, Hadfield S, Lichtenwalner A, Brzozowski RJ, Settlemyre CT, Shoenian SB, Cockett N. Identification of Genetic Regions Influencing Footrot in Sheep. Plant and Animal Genome XXI Conference, San Diego CA. 2013.

## Other UMaine SR Projects

- CL surveillance study
- Ovine *H. contortus* study
- EWE Maine Club



## Scoring Footrot Lesions



All photos by  
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## Evaluate the Whole Foot

- Clean by brushing or spraying
- Look at interdigital skin
- Look at sole (bottom of foot)
- Look at “white line”
  - May need to trim excess (folded) wall first
  - Differentiate between “pockets” and active lesions



## Scoring system: original

- 1= no sign of infection
- 2= inflammation of interdigital skin, possible odor
- 3= odor, undermining/separation, lameness
- 4= excessive undermining; two or more feet affected, odor
- 5= chronic carrier (deformed feet)

## Scoring system: evolved

- 1= no sign of infection
- 2= inflammation of interdigital skin, odor, undermining/separation, lameness
- 3= Score 2 with two or more feet affected
- Chronic carrier=  
deformed feet; no active infection
- Pockets: no odor, some defect in wall/sole, no evidence of active infection

## Scoring system: evolved

- 1= no sign of infection
- 2= inflammation of interdigital skin, odor, undermining/separation, lameness
- 3= Score 2 with two or more feet affected
- Chronic carrier=  
deformed feet; no active infection
- Pockets: no odor, some defect in wall/sole, no evidence of active infection

## Proper Tools

- Hoof knife and trimmers:
  - Sharpen with file/stone
  - Disinfect between sheep
  - Oil between uses



## Sheep Restraint

- “Tip” the sheep
- Restrain in a “cradle”
  - proper positioning in a metal and mesh cradle
  - Feet are easily and quickly trimmed
  - Most sheep become passive when “tipped”



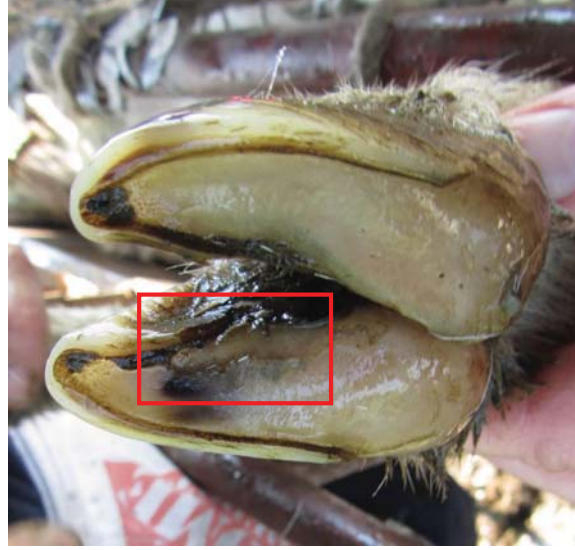
Tip Tables



Score 1=Clean

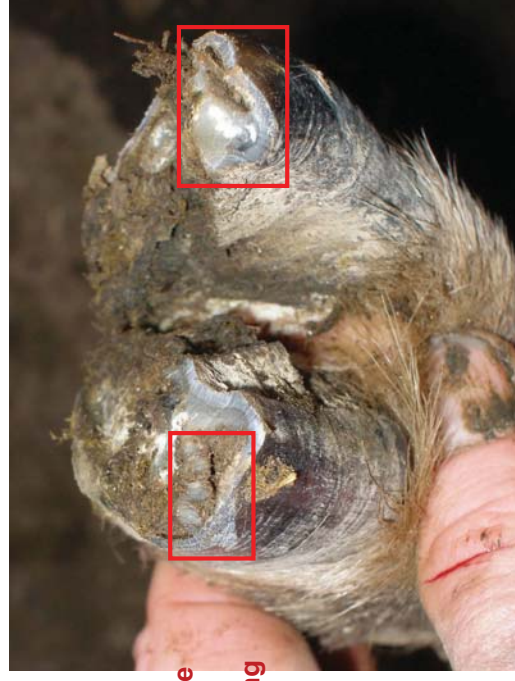


## Score 1 with Pocket



**Pocket along sole and medial wall: no odor, no abnormal discharge**

## Score 2: Active Lesions



**Trimming the toes reveals underrunning of the sole**

**Pockets: if no infection (odor, fluid), may be healing**

## Score 2: Active Lesions



- Deep defect in white line
- Foul smell

## Score 2: Active Lesions

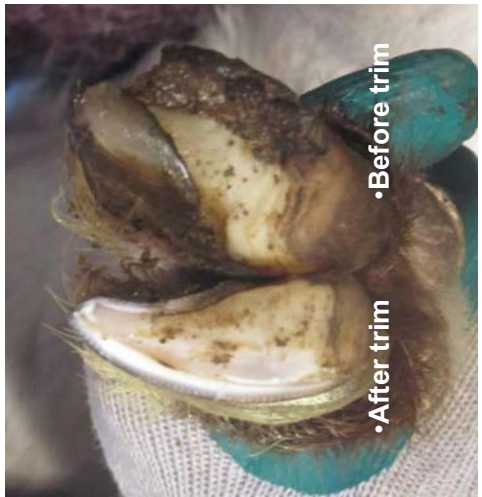


- Deep defect in sole
- Foul smell



## Score 2 Trimmed

- Complete removal of infected material is possible



## Score 3: 2 or more feet with footrot

Note severe  
underrunning  
of medial wall



## Chronic Carriers: Cull

- Even after trimming, hooves will be deformed



## Chronic Footrot

- Deep, long-standing infection
  - Deformed foot
- Thick walls
- Non-uniform
- Defects may extend to coronary band
- **Culling is necessary**

