Flooring, temperament and foot problems: links to foot issues in the feedlot

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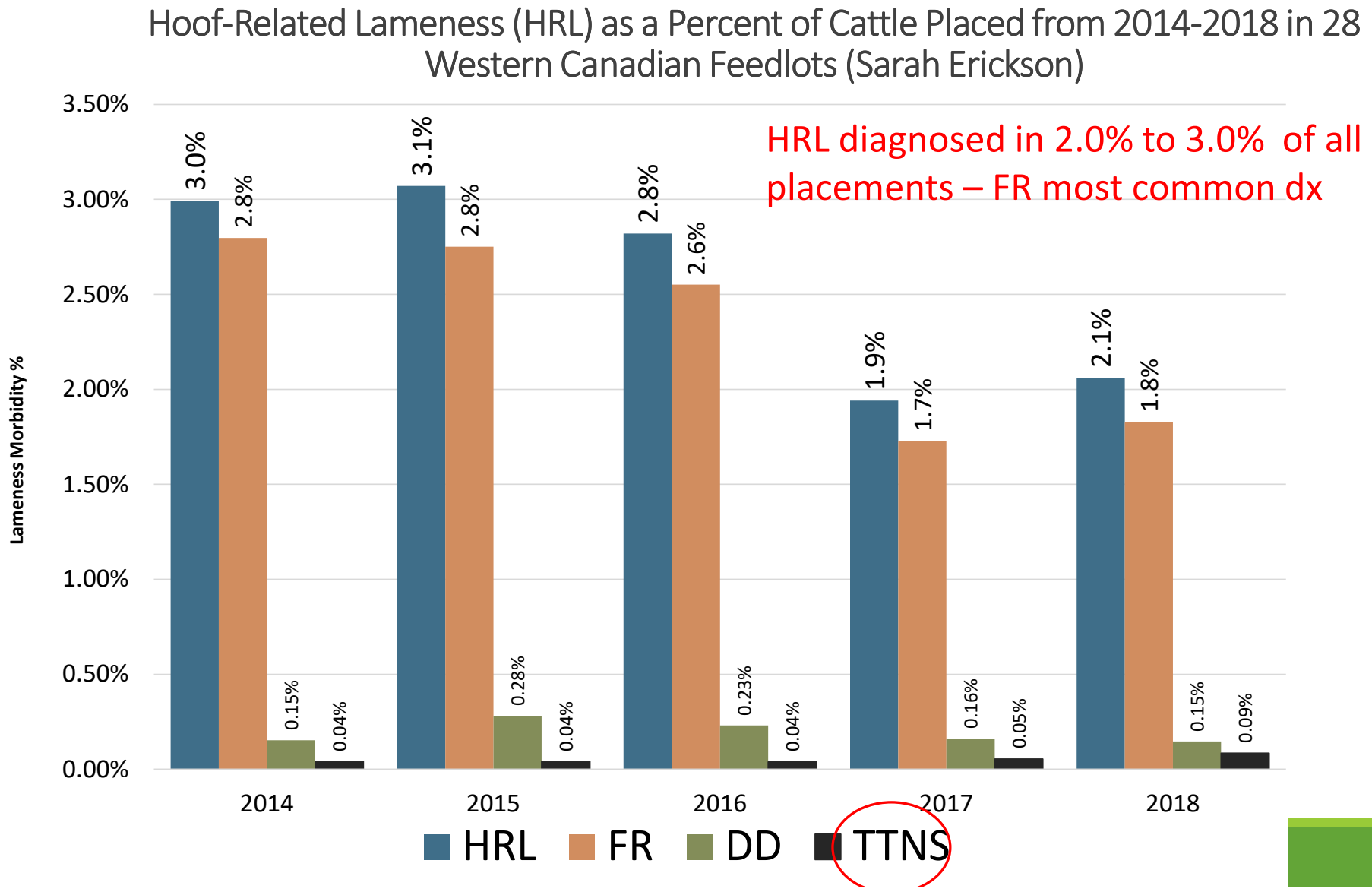
Feedlot lameness – how big is the issue?

- What percentage of your feedlot treatments are for lameness?
- Hendrick and Abesykara (western Canada) – multi-year study (2008-2013) found lameness accounted for **40%** of treatments.
- Davis-Unger *et al*, 2019 - southern Alberta 10-year study of 28 feed lots found that lameness accounted for **32%** of treatments, range 1.3 to 46% .
- Marti *et al,* 2021 - two-year study of two Alberta feedlots found lameness accounted for **36%** of treatments.

Feedlot Lameness

- Sarah Erickson – 2022 (FHMS by TELUS Agriculture), 5-year study (2014-2018) of 1.77 M head, lameness accounts for **25.7%** of all treatments.
  - **Hoof-Related lameness (HRL)**: **70.8%** of lameness treatments and **18.3%** of all feedlot treatments, of which ~90% of HRL are foot rot.
- Terrell *et al*, 2013 – Nutritionists, veterinarians and feedlot owners rank **foot rot**, **injuries** and **toe abscesses** as the most common causes of lameness.


Hoof-Related Lameness (HRL) as a Percent of Cattle Placed from 2014-2018 in 28 Western Canadian Feedlots (Sarah Erickson)
HRL diagnosed in 2.0% to 3.0% of all placements – FR most common dx
Lameness Morbidity %
3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
3.0%
2.8%
0.15%
0.04%
3.1%
2.8%
0.28%
0.04%
2.8%
2.6%
0.23%
0.04%
1.9%
1.7%
0.16%
0.05%
2.1%
1.8%
0.15%
0.09%
2014
2015
2016
2017
2018
HRL
FR
DD
TTNS

Cost of lameness (Davis-Unger *et al*, 2017)

- Davis-Unger *et al*, 2017
- Health costs = treatments costs, lost performance, and death
- Lame cattle average 48.5 lbs less than their healthy pen mates

Average return on healthy cattle = $690.

- Average return on cattle treated for **Foot rot** = $568
- Average return on cattle with **injuries** = $259
- Average return on cattle treated for **joint infections** = -$286
- Average return on cattle treated for TTNS cases (lameness with no visible swelling) = - $701

Toe Tip Necrosis Syndrome (TTNS)

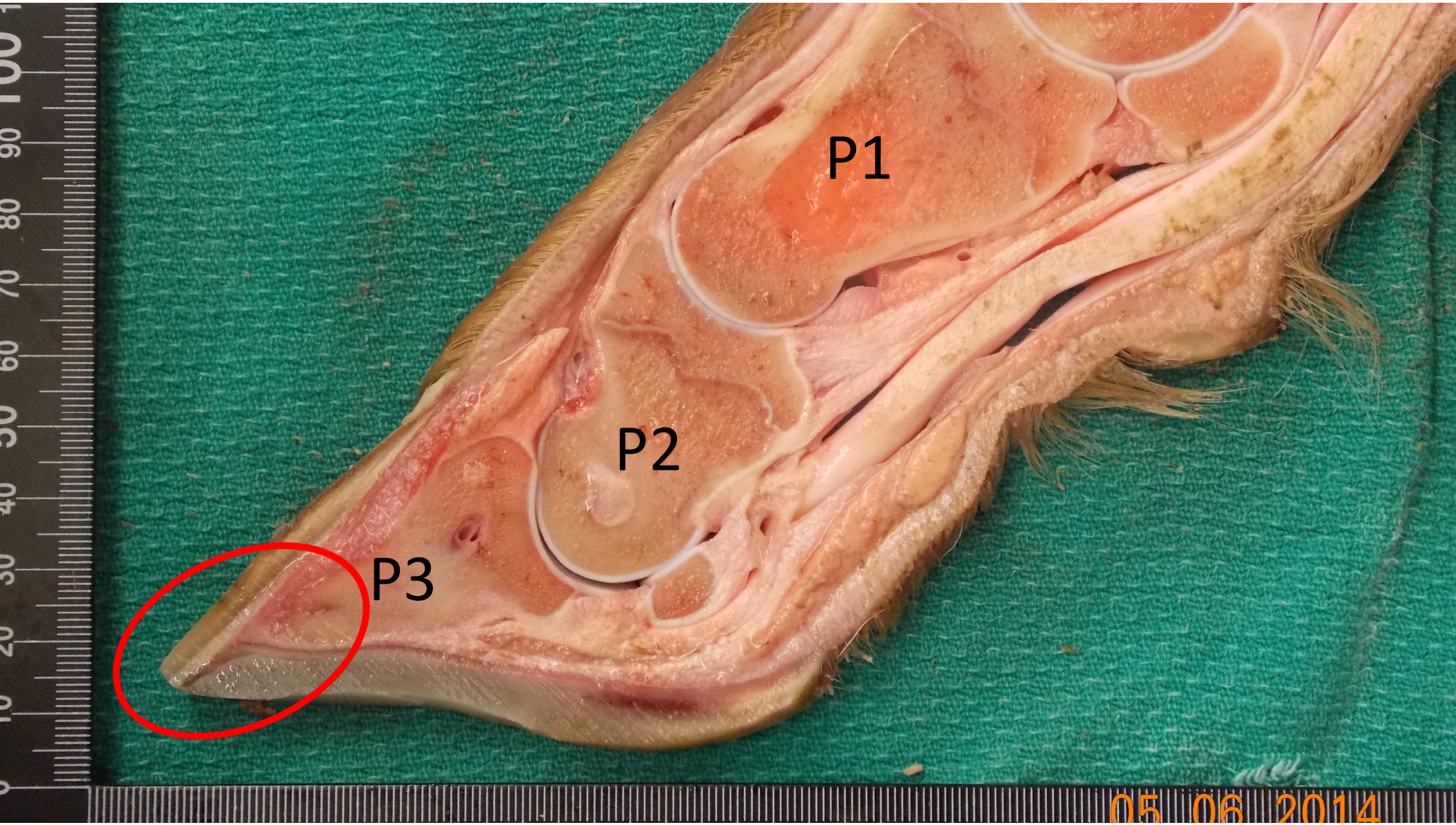
- A disease known by many names:
  - **Toe abscess**
  - Toe necrosis
  - P3 necrosis
  - Foot lesions (FTL)
  - Apicus necrotica
  - Apical white line disease
  - Apical pedal bone necrosis

- Technically an ulcer; however, creates confusion with toe ulcers (TU) and thin sole toe ulcers (TSTU) of dairy cattle.

Toe tip necrosis *syndrome* (TTNS)

- Describes the continuum of disease presentations
- White line separation resulting in necrosis *and* lameness
- Involvement of the bones of the hoof (P3, Pedal or Coffin bone), tendons, muscles, cellulitis, and evidence of bacteremia such as embolic pneumonia

Quick anatomy lesson


P1
P2
P3
05 06 2014

TTNS – not a ‘new’ disease

- Dewes HF. ***Transit-related lameness in a group of Jersey heifers***. NZ Vet J **1979**

- Sick FL, Beeker CM, Mouw JK, Thompson WS. ***Toe abscesses in recently shipped feeder cattle*** (Veterinary Medicine/Small Animal Clinician, **1982**)

- Miskimins DW. ***Bovine toe abscesses*** (Proceedings 8th International Symposium on the disorders of the ruminant digit, Banff, Alberta **1994**).

Description of TTNS

- H**indlimb lameness** seen within **days to weeks** of arrival to feedlot
- **No obvious swelling** of foot, often misdiagnosed with foot rot or trauma
- Tip of toe is worn, **white line separation**
- Toe lesion has **grey pus, dry-black material**,
- Ascending infection, and on PM examination evidence of **bacteremia**
- Risk factors: **"high-spirited",** abrasive flooring, handling, soft hooves (wet season)
- Treatment/Outcome – **poor response to antimicrobials**, trim toes to effect drainage, place on soft, dry flooring

What does TTNS look like?

Courtesy of FHMS

Diagnosis

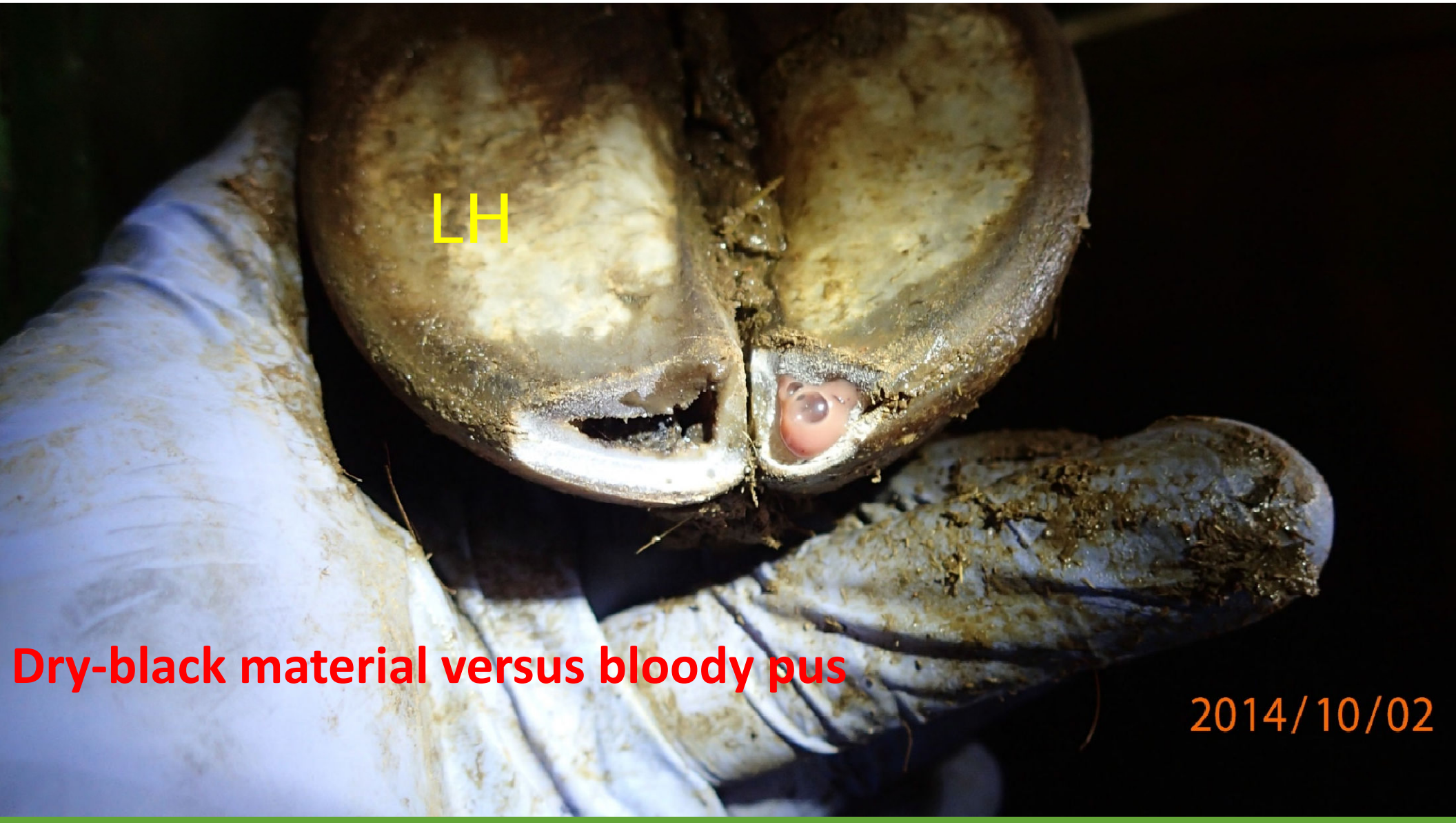

LH
Normal or infected?
2014/10/02


RH
Normal or infected?
2014/10/09

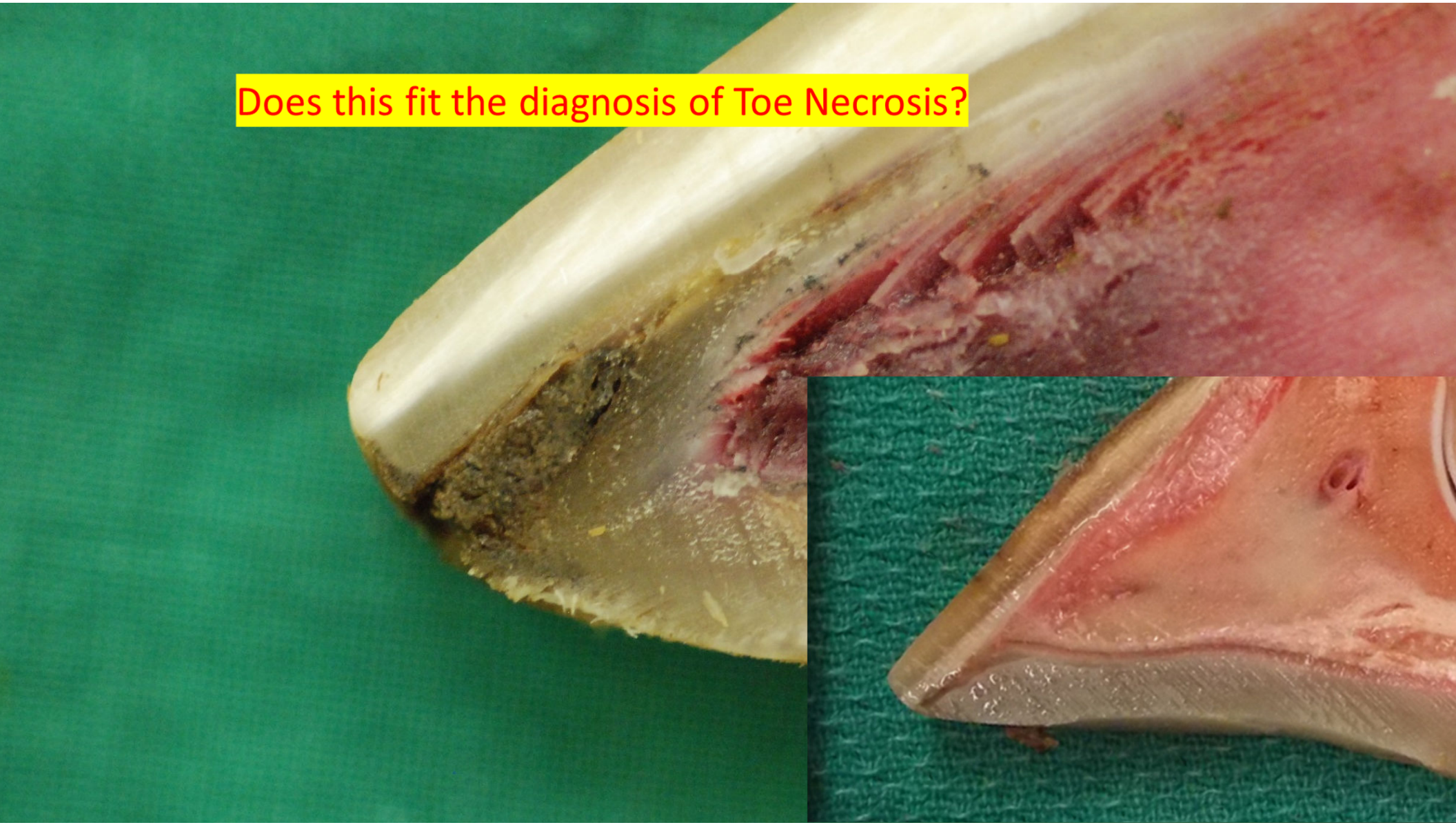

Normal or infected?
2014/11/06


2014/10/09


RH

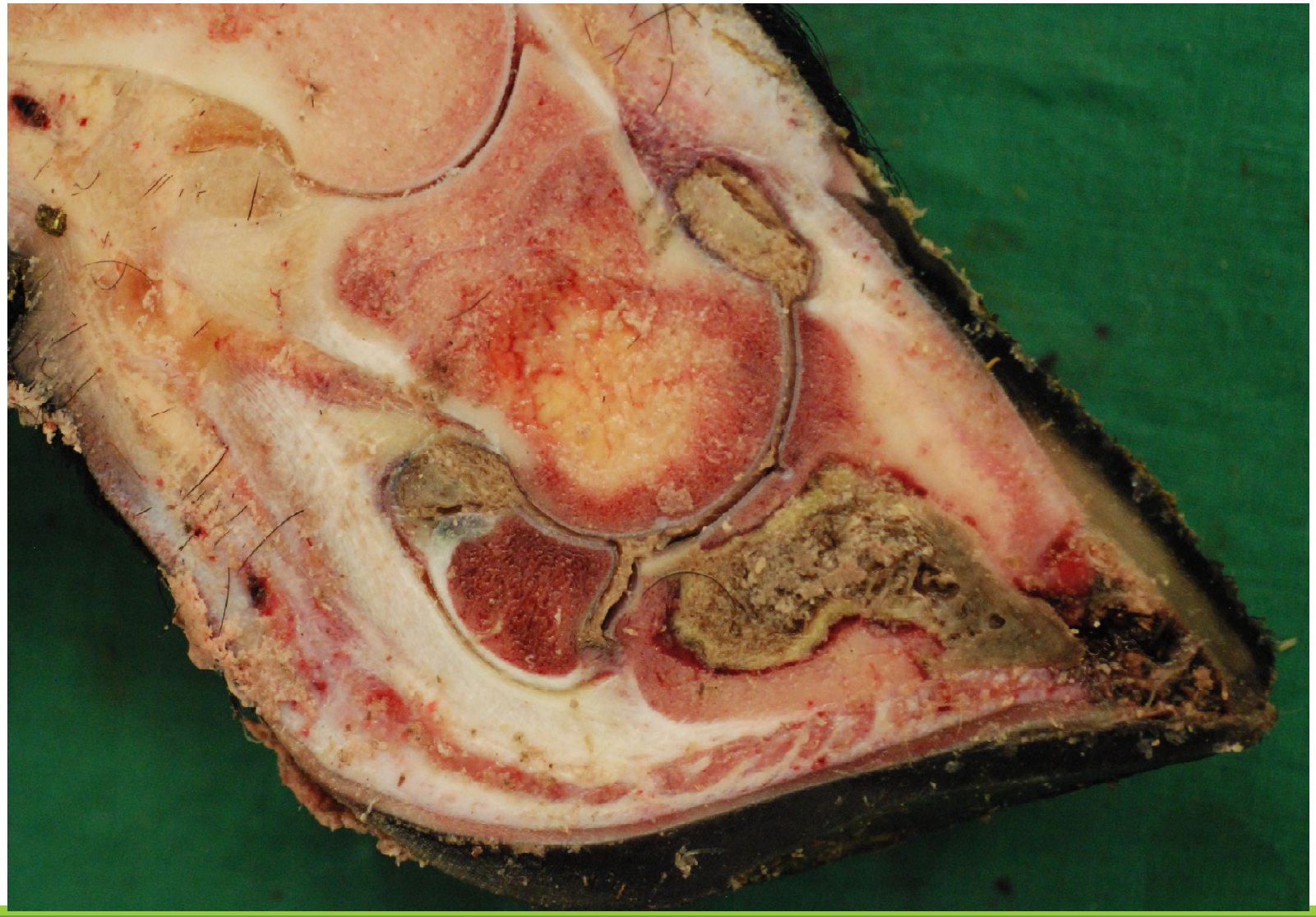

LH
Dry-black material versus bloody pus
2014/10/02

Postmortem findings

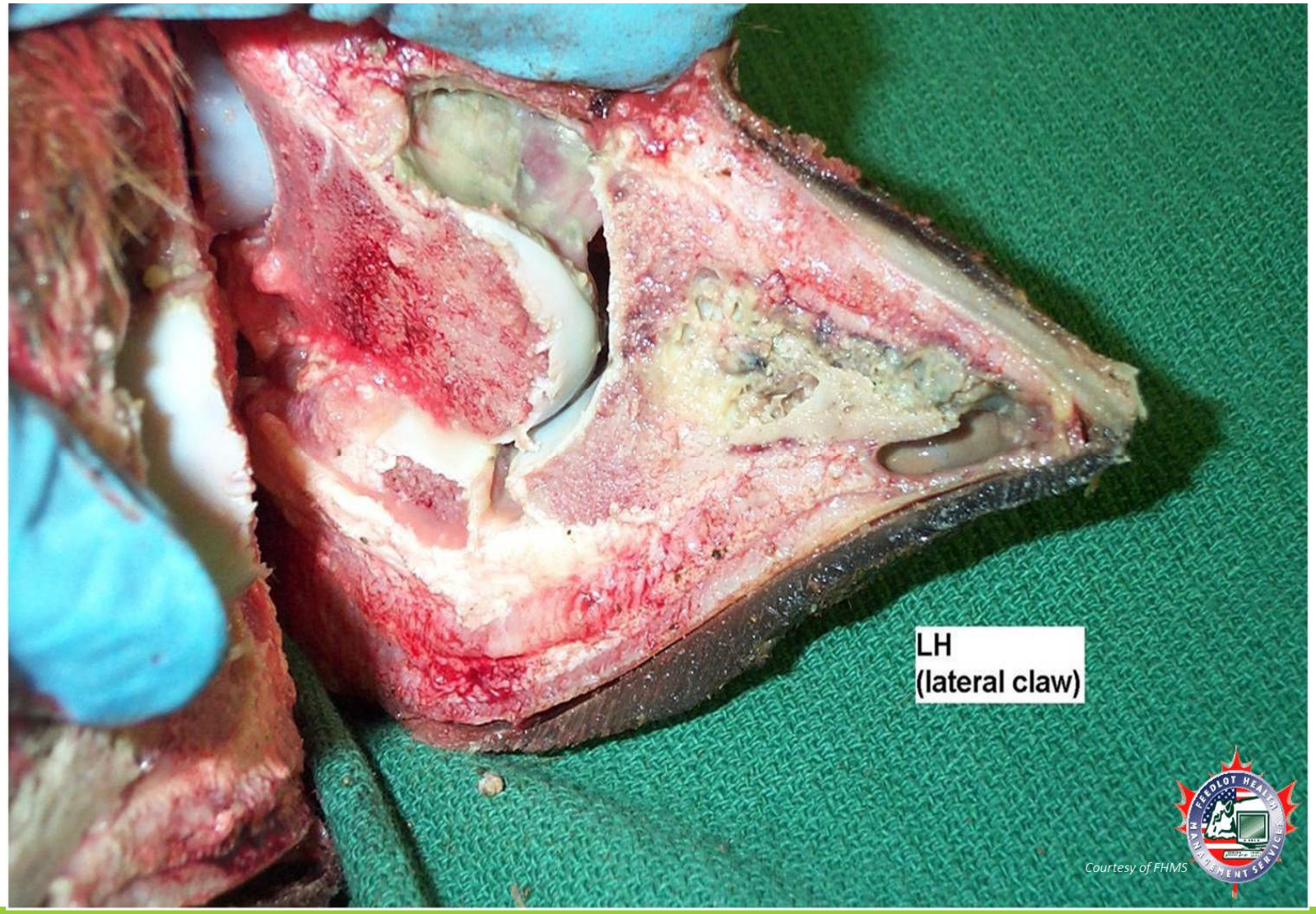

Does this fit the diagnosis of Toe Necrosis?

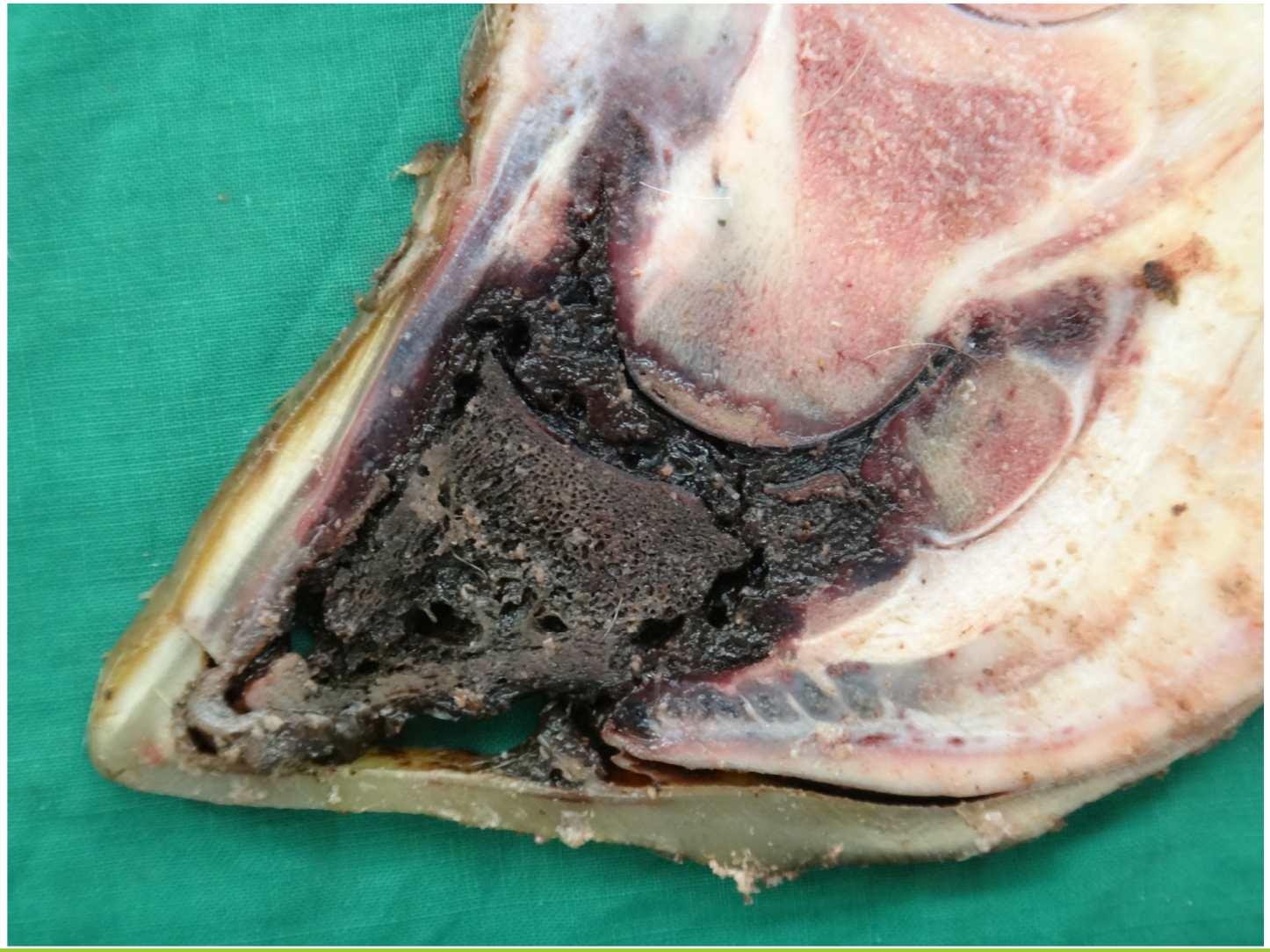

Courtesy of Dr. Andy Allen

Courtesy of A. Allen

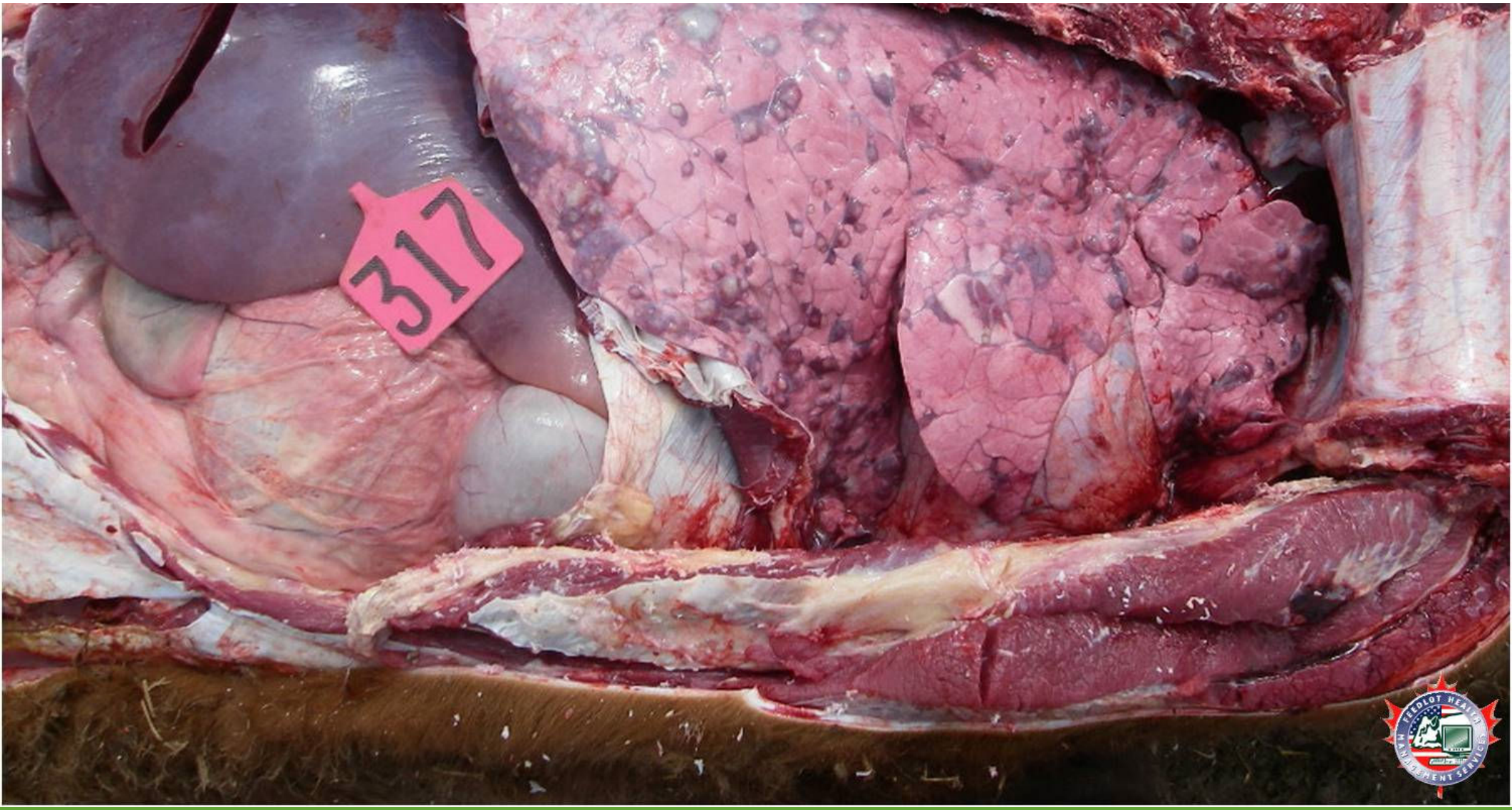


Courtesy of A. Allen


LH
(lateral claw)
Courtesy of FHMS




2014/10/09


317

Start of our research, we asked ourselves

- Does the infection start from inside the hoof and move out or vice versa?
- Why does it appear to be related to high-strung cattle?
- What role does the feedlot play – flooring, handling, etc?
- Is it more common in groups of cattle (lots) or certain feedlots?
- Is it a disease of calves/yearlings, heifers/steers?
- What bacteria/viruses may be related to the disease?

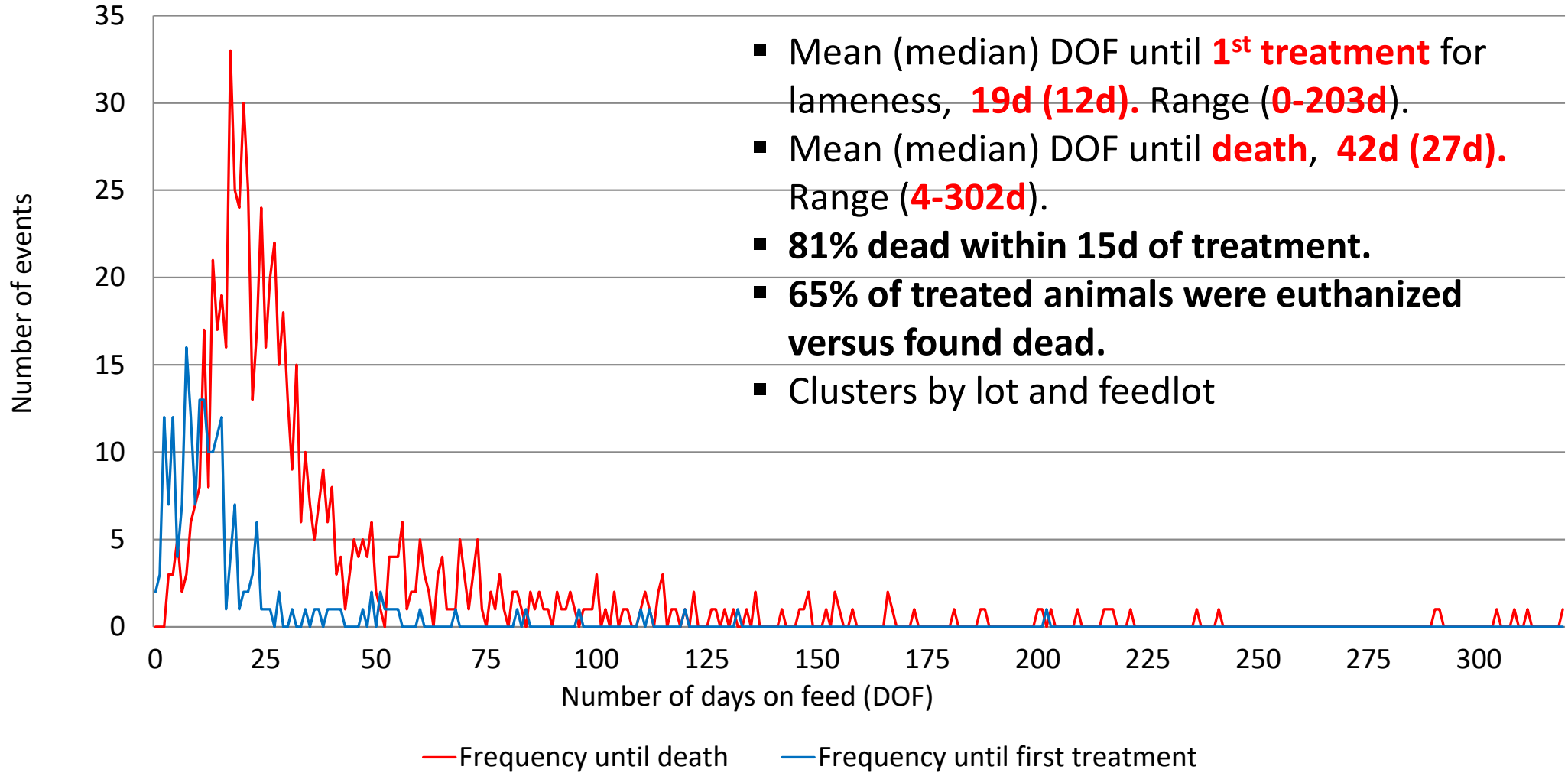
Started with describing the disease

Materials and Methods

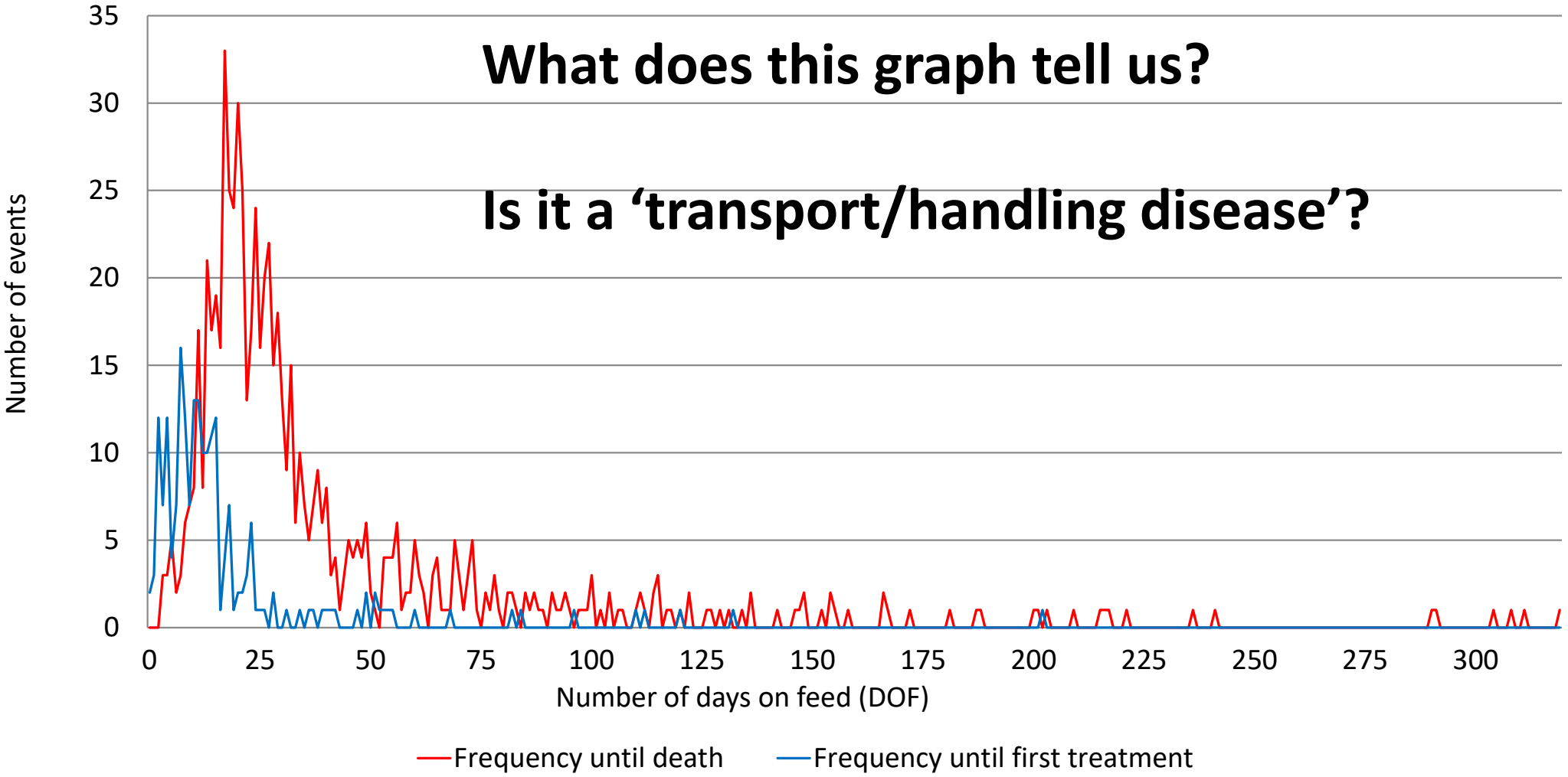
- 1,904 cattle lots (>100 head) from 48 feed yards.
- **702 confirmed cases of TTNS**
- Days on feed until first treatment and death, age class, death date, source of animals, weights, gender, and outcome.

Results:

- Only **72/1904 lots had ≥ 1 case** (lot prevalence **0.50-1.22%**)
- **45% calves, 55% yearlings**
- **78% auction-derived**, 12% ranch direct, 10% background
- **September-November**

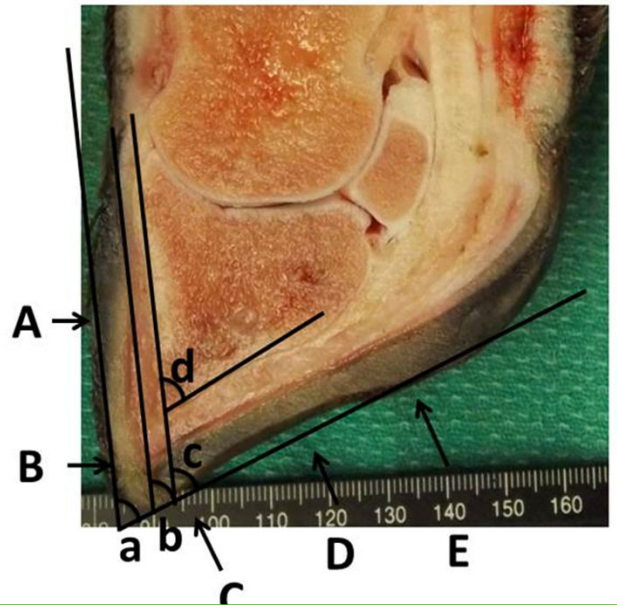


- Mean (median) DOF until **1st treatment** for lameness, **19d (12d).** Range (**0-203d**).
- Mean (median) DOF until **death**, **42d (27d).** Range (**4-302d**).
- **81% dead within 15d of treatment.**
- **65% of treated animals were euthanized versus found dead.**
- Clusters by lot and feedlot


What does this graph tell us?
Is it a ‘transport/handling disease’?
Number of events
35
30
25
20
15
10
5
0
0
25
50
75
100
125
150
175
200
225
250
275
300
Number of days on feed (DOF)
Frequency until death
Frequency until first treatment

Sorting out the risk factors for TTNS

- 94 healthy and 93 diseased feet
- Practitioners from three feedlot practices submitted fresh feet and formalin fixed skin and cardiac tissue
  - Feet were sectioned
  - Culture swab
  - Pathology: vasculitis
  - BVDV, *Histophilus somni*

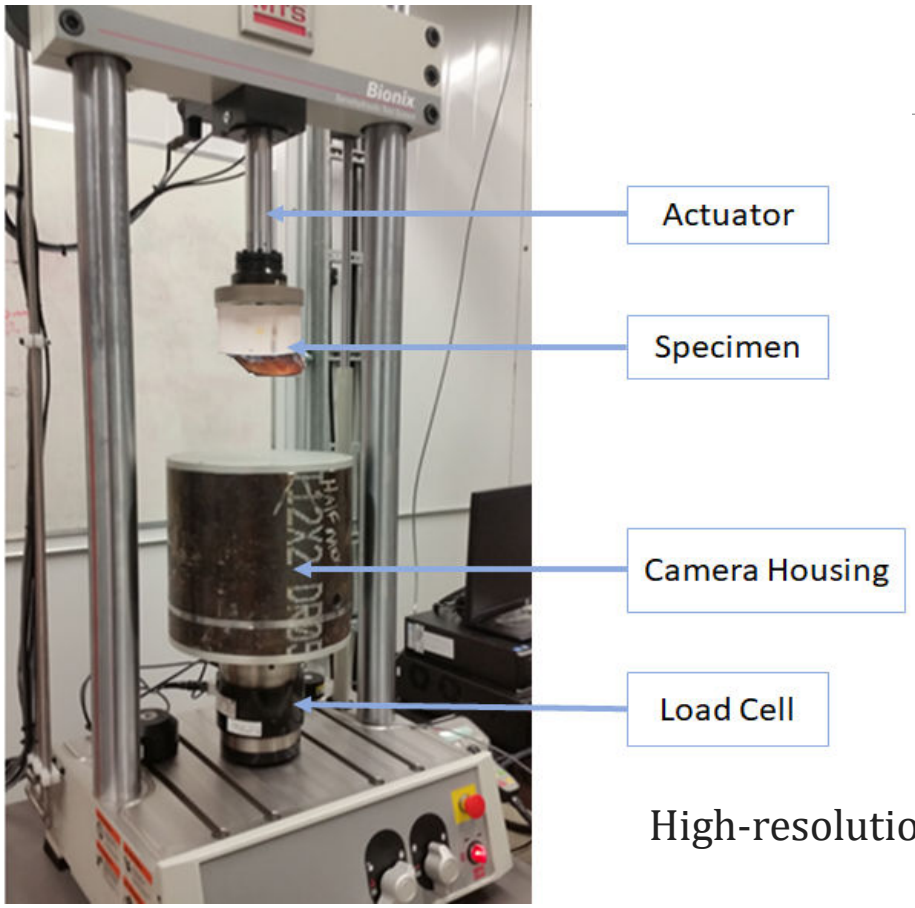


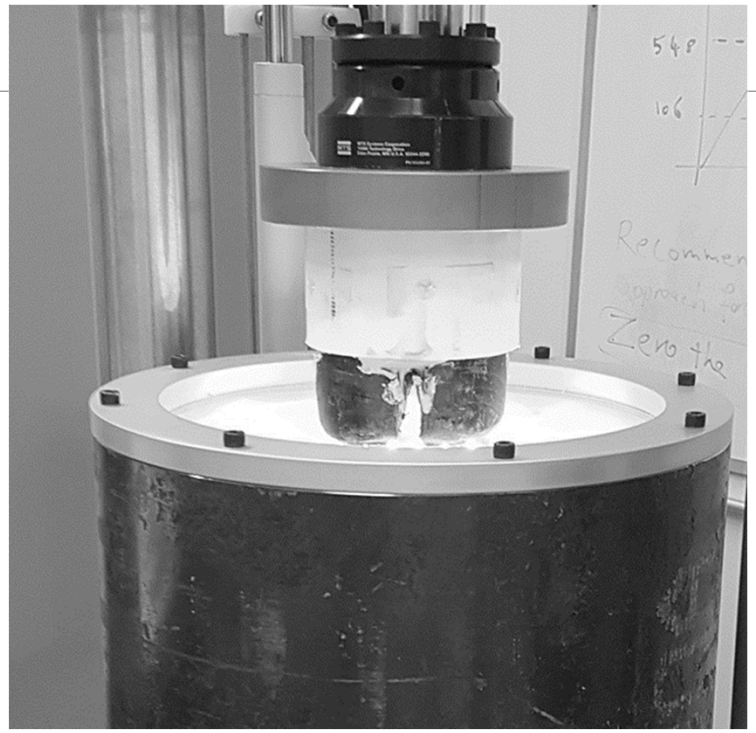
Results

- **Thinner sole thickness at tip of toe**, no P3 rotation
- Cases always progressed from **white line into the P3 bone**
- Cases with heavy overgrowth of *E. coli* and *Trueperella pyogenes*
- Cases 4.4 times more likely to test positive for **BVDV** (immunohistochemistry)
- Cases had **lower Mg** concentrations in both solar and hoof wall horn tissue, could also be an indicator of deficiencies in Ca, S and P?

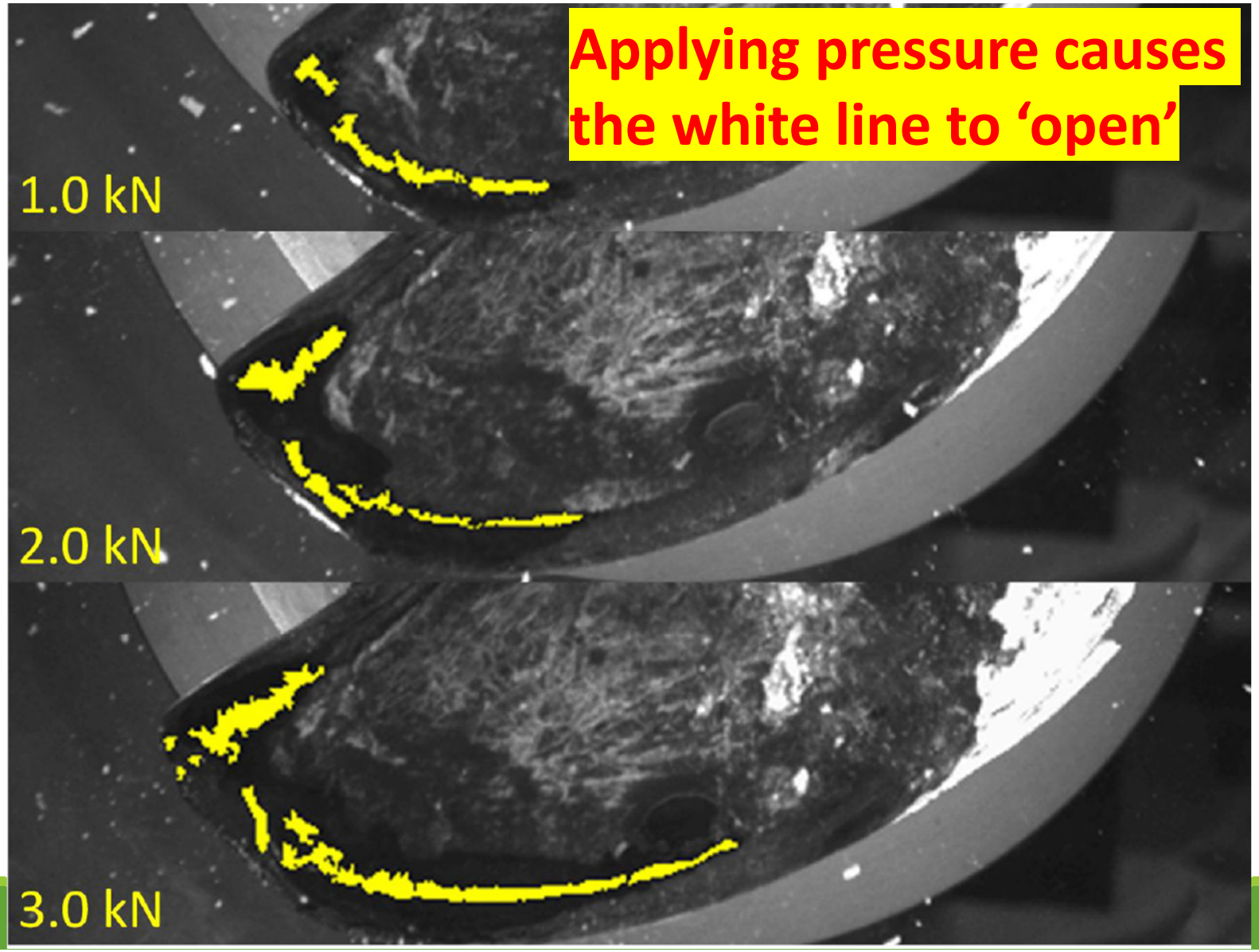
Next – we needed to explain this?

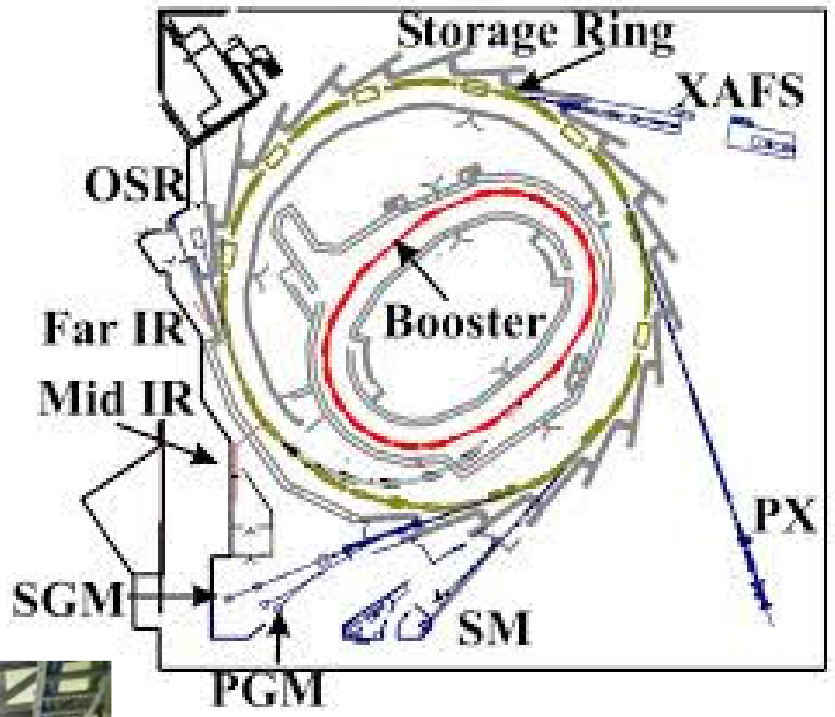
‘High tech’ approach (HR-pQCT and CLS)

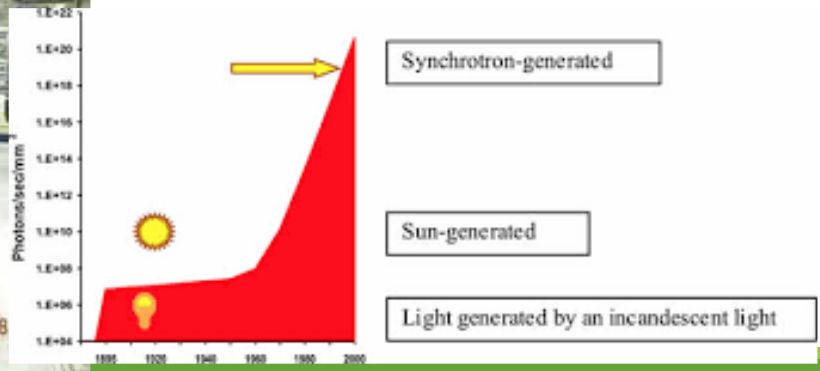




High-resolution peripheral quantitative computed tomography (HR-pQCT)


Applying pressure causes the white line to 'open'
1.0 kN
2.0 kN
3.0 kN


Storage Ring
XAFS
OSR
Booster
Far IR
Mid IR
PX
SGM
SM
PGM


Photons/sec/mm
Synchrotron-generated
Sun-generated
Light generated by an incandescent light


EMERGENCY STOP
MAY LIFT & LAPS
HUBER

Results – visualized the ‘channels’ the bacteria can invade.

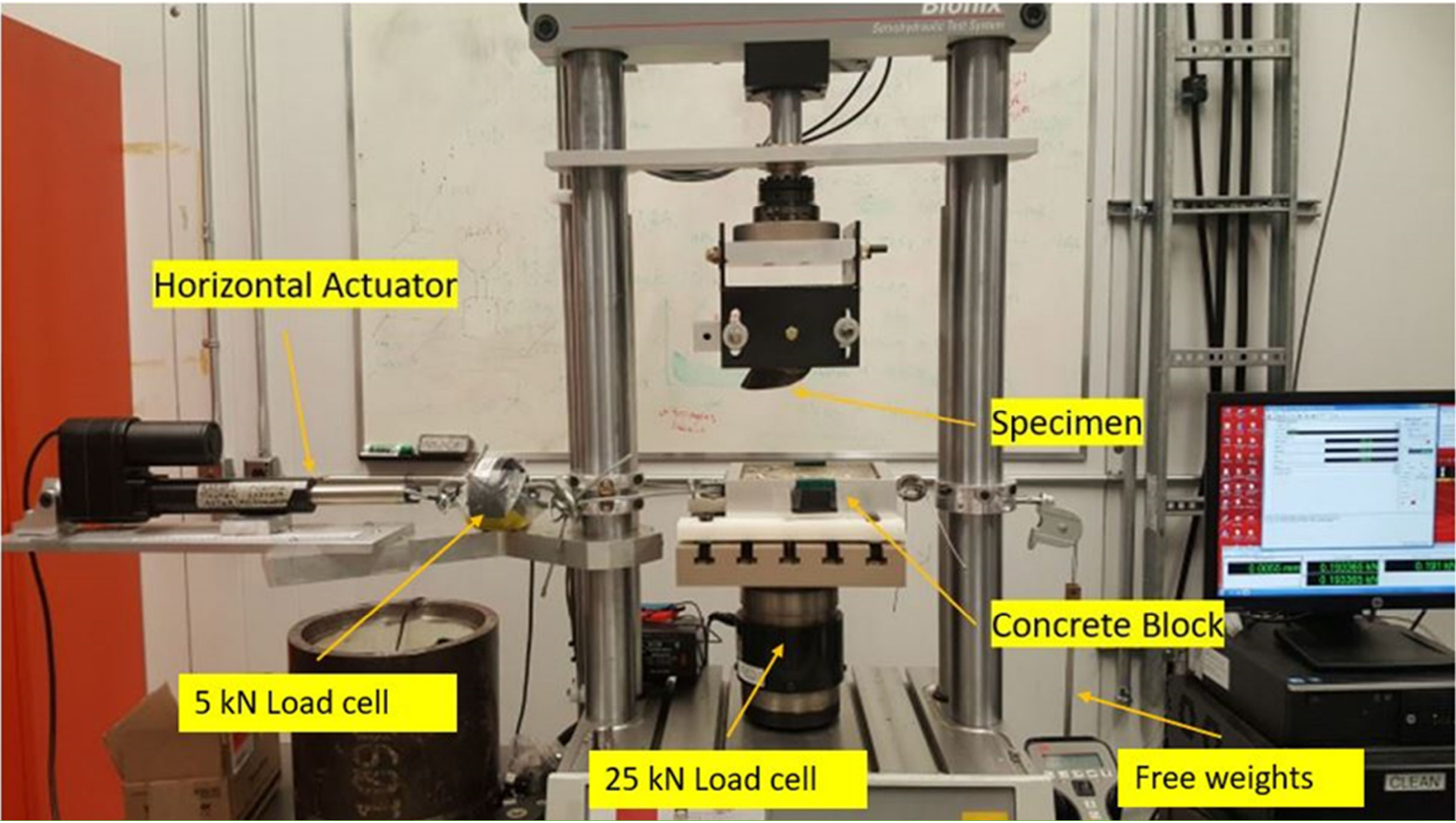
Now what do we know? Or suspect?

- Animal develops white line separation
- Bacteria from pen colonize the white line, release enzymes that break-down the white line
- Weight of animal, causes the white line to separate, more bacteria/dirt gets in the lesion, leading to more separation
- The lesion finally begins to ‘gape’ open when weight-bearing, allowing even more material to get trapped within the foot
- Infection penetrates P3 and ‘game over’

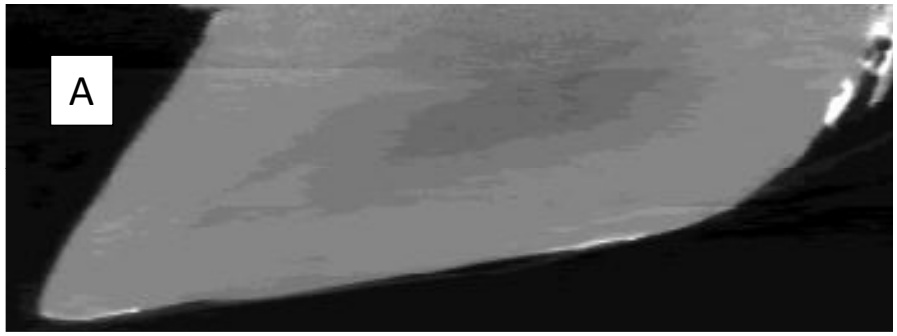
But, missing one important piece to the puzzle? How/why does the white line separate?

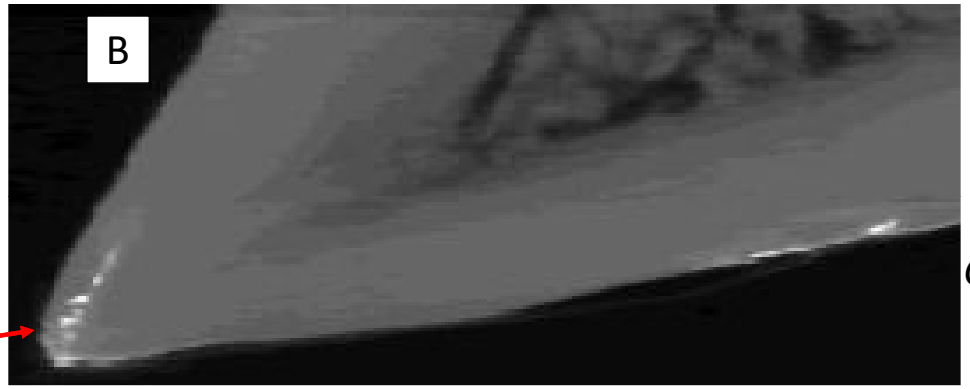
- "Abrasion theory"
  - Excitable cattle pushing in chutes
  - From heavily muscled back limbs
  - Claws rasp on floor – explains why apex of hoof sole is thinner
  - Clusters by lot – excitable, pasture nutrition, wet environment

- **Onto the 'Drag Test" to see if we can prove our theory**


Horizontal Actuator
Specimen
Concrete Block
5 kN Load cell
25 kN Load cell
Free weights

HR-pQCT scan showing no contrast agent before dragging (A) and contrast agent sucked into the claw after dragging occurred (B)





Pathway created for bacteria to enter after dragging

HR-pQCT

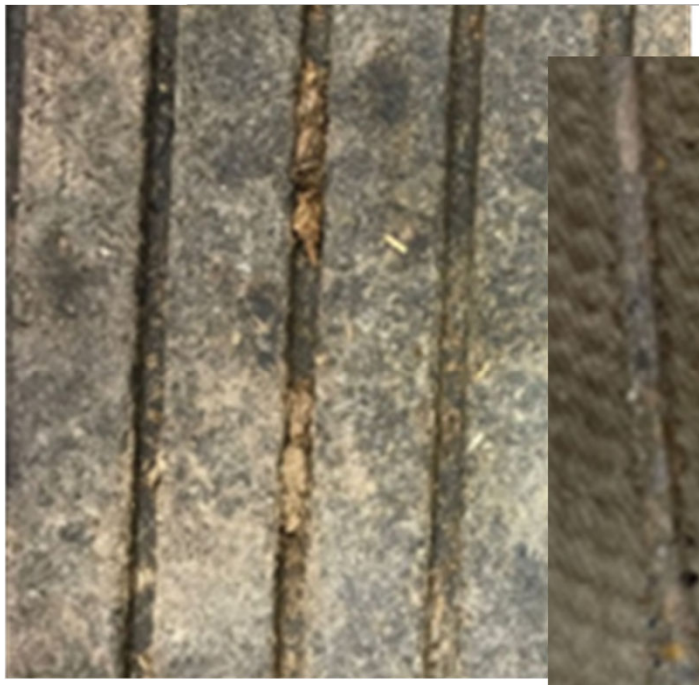
Gadolinium Suction

Next – let's go look at flooring!

- Library of all flooring from trailers to auctions and feedlots

What is this – what is it used for???

Next – assessed the effects of gravel on claw wear with different floorings (rubber, concrete, sand).



Results

- 155% greater wear with concrete surface with presence of gravel
- No difference in wear with rubber surface with or without presence of gravel

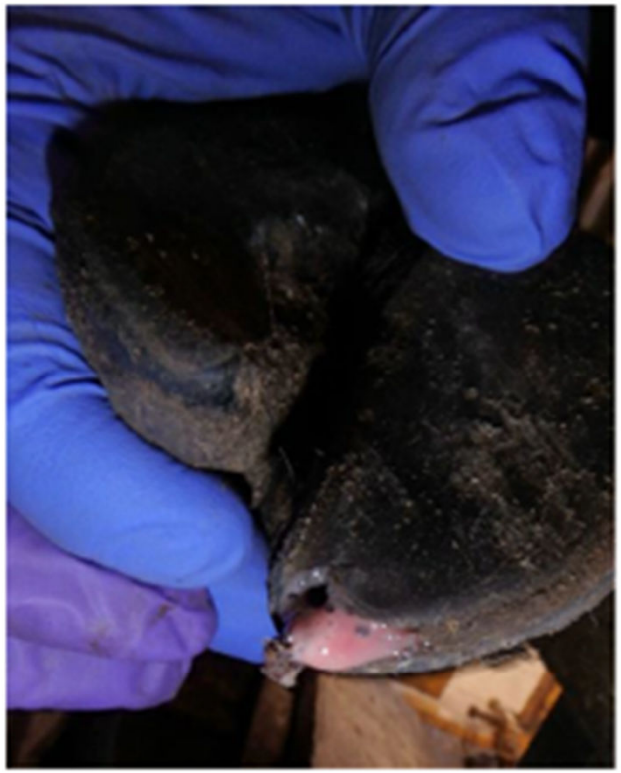
Treatment

- **Aggressive trimming – diagnosis and treatment in one**
- Antimicrobials and NSAIDS
- Claw amputation
- Euthanasia

Case study – treatment and recovery

- 95 Angus X cattle shipped ~90 km to auction and then ~25 km to feedlot
- Within 48 h high prevalence of lameness
- 21 head returned to auction with degrees of lameness
- All diagnosed with TTNS of varying degrees
- Monitored for 7 months
- 16 of 21 recovered and were sent to slaughter
- EXTREMELY EXCITABLE

1290 – TTN #11 Pink
Wk 0 – Oct 31



HR

HL

Left hind

Right hind

- Primary aggressive bone disease consistent with osteomyelitis of the distal 3rd phalanx of lateral (4th) digit of both the right and left hind feet.
- Medial digits of both hind feet; Normal.

1290 – TTN #11 Pink
Wk 0 – Oct 31

HR

HL

Wk 1 – Nov 7

HR

HL

Wk 2 – Nov 15

HR

HL

Wk 3 – Nov 21

HR

****

HL

1290 – TTN #11 Pink
Wk 4 – Nov 28

HR

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HL

Wk 5 – Dec 6

HR

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HL

Wk 7 – Dec 20

HR

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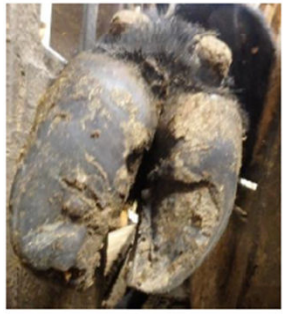

HL

Wk 9 – Jan 3

HR

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HL

1290 – TTN #11 Pink
Wk 11 – Jan 17 2019

HR

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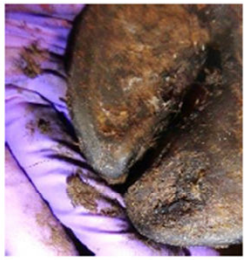
HL

Wk 13 – Jan 31

HR



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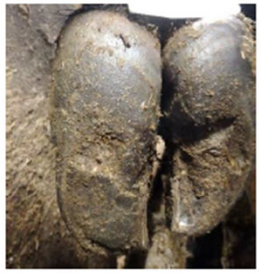

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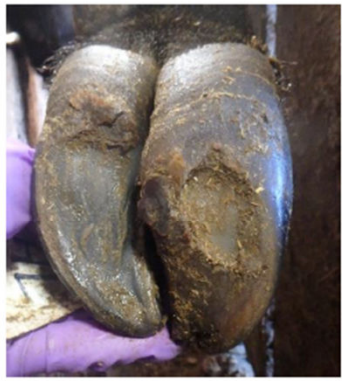
Wk 15 – Feb 21



HR

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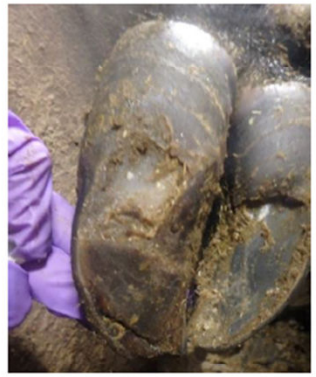

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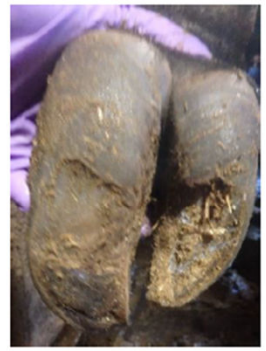
Wk 18 – Mar 14



HR

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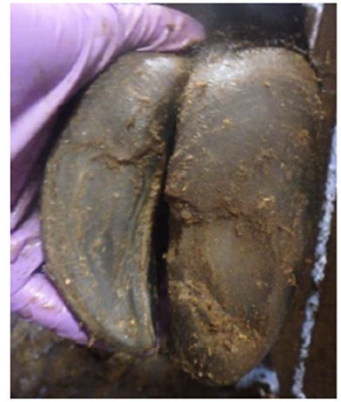

HL

Take home points

- TTNS may be starting at the auctions
- Related to excitable cattle – perhaps worse going forward?
- Use low-stress handling
- Avoid gravel - use sand?
- Can be treated with aggressive trimming and antibiotics
- Last resort is claw amputation but need to check other claws because often more than 1 claw affected.

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