

Elk Hoof Disease in Southwest Washington

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Wild Ungulate Hoof Diseases

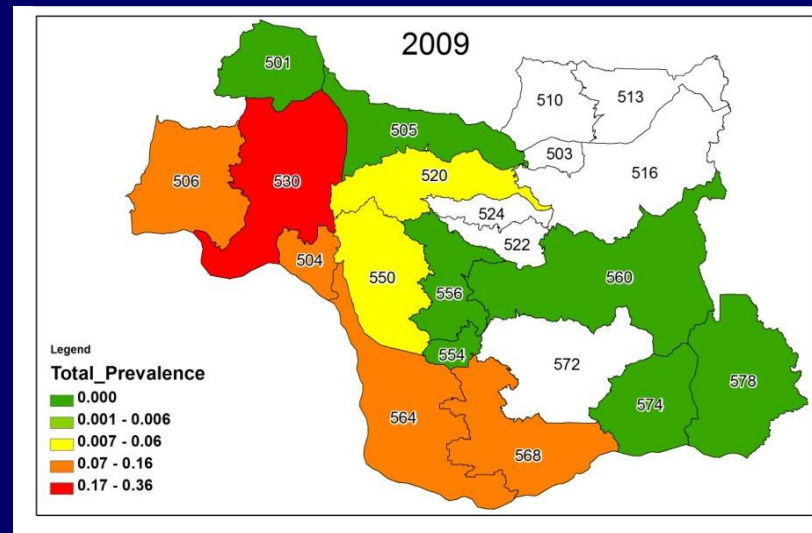
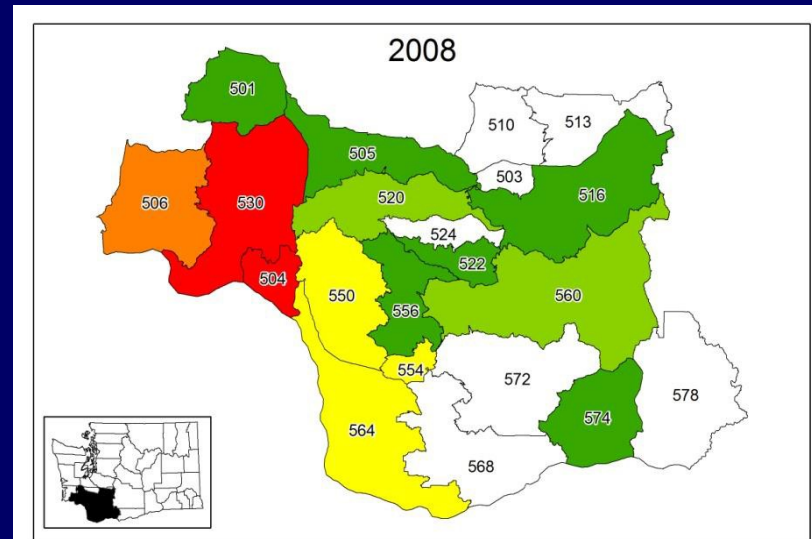
- Usually sporadic and many different causes
- Below are photos from an elk, a moose, and a mule deer, each with a different hoof disease, all collected during Fall 2012 in Eastern WA



Examples of Deformed Elk Hooves



Prevalence and Distribution 2008-2009



Diagnostic Investigation Partners

Assistance of Veterinary Personnel From:

- WDFW
- Washington State University
- University of Washington
- ODFW
- Oregon State University
- University of Wisconsin
- Tufts University
- WSDA

Samples Sent to Veterinary Diagnostic or Research Labs At:

- Washington State University
- University of Idaho
- Colorado State University
- University of Wyoming
- University of Liverpool (U.K.)
- USDA National Veterinary Services Laboratory
- USDA National Animal Disease Center
- UC Davis

Diagnostic Investigation

- Gross necropsy
- Radiology
- Histology
- Parasitology
- Virus isolation
- Trace minerals
- Routine bacteriology
- Specialized bacteriology



Collections

- **March 2009 : adult cows**
 - 3 unaffected area -- East of I-5
 - 5 affected area -- Lewis/Cowlitz Co.
- **Feb/Mar 2013: 9-10 month old calves**
 - 3 unaffected area -- Pacific County
 - 4 unaffected area -- Yakima / Kittitas Co.
 - 9 affected area -- Lewis / Cowlitz Co.
- **August 2013: 3 month old calves**
 - 2 unaffected area -- Grays Harbor Co.
 - 5 affected area -- Lewis Co.
- **January 2014: 8 month old calves**
 - 2 unaffected area -- Kittitas Co.
 - 9 affected area --Cowlitz, Wahkiakum, Pacific, Grays Harbor Co.

Nostrils			
Oral Cavity			
Tongue		H	lung worms (murd/white) coming out in + taken for protozoal
Skin (earnotch, vent neck)		H	
Vulva/Penis			
Anus			
Mammary gland			
INTERNAL EXAM			
Brain		H, VI, T - foil	also took meninges
Subcutaneous tissue			
Pre-scap LN (scap LN)		H (cassette)	
Trachea (w/esoph & thy)		H	
Thyroid & parathyroid		H	
Blood - RTT & LTT		S	pericardial fluid
Bronchi/bronchioles			lung worm
Lung		VI	
DV x 2 sides		H	
CV x 2 sides		H	
Mediastinal LNs (med LN)		H (cassette)	
Thymus		VI	not observed
Heart (long sec of walls)		H	
Major vessels			
Diaphragm		H	
Mesenteric fat		T- foil	very little mesenteric fat
Liver		H, VI, T x 3 - foil	
Spleen		H, VI	
Mesenteric LNs (mes LN)		H (cassette)	
Kidney		H (L&R), VI, Tx3 - foil	
Adrenal glands (L & R)		H	
Ovaries/Testicles			
Uterus			immature
Bladder		H	
Urine		S (RT vial)	empty bladder
Skeletal muscle		H, S (EtOH, cryo)	
Popliteal LN (pop LN)		H (cassette)	
Bone Physis		H	
Bone marrow (mid-femur)		S - bag	1 gelatinous
Esophagus			
Rumen		H	Look for ulcers!
Rumen contents		S - bag	
Reticulum			
Omasum			

SEVERE HOOF DISEASE IN FREE-RANGING ROOSEVELT ELK (*CERVUS ELAPHUS ROOSEVELTI*) IN SOUTHWESTERN WASHINGTON, USA

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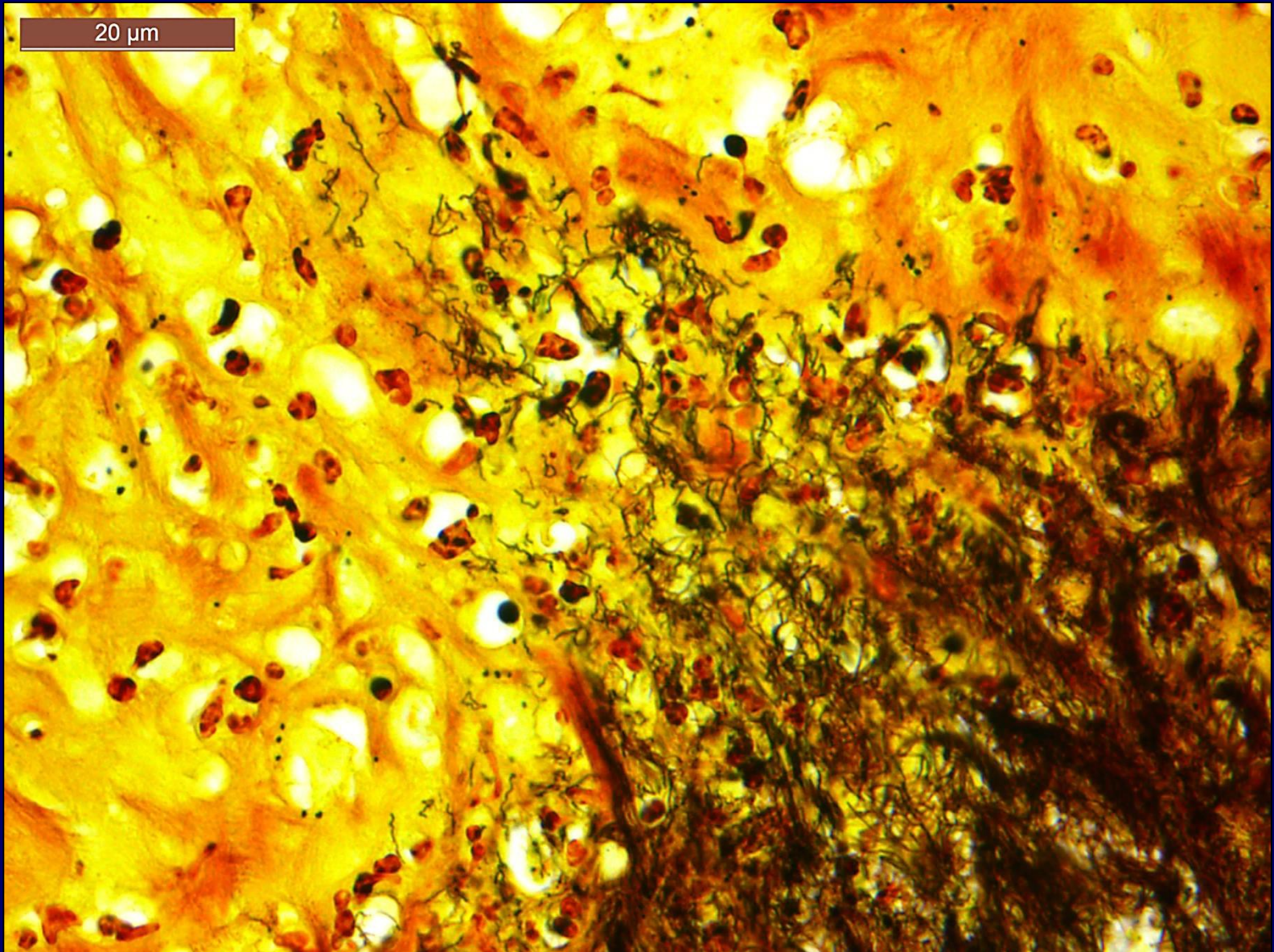
ABSTRACT: Reports of free-ranging Roosevelt elk (*Cervus elaphus roosevelti*) with abnormal hooves and lameness increased significantly in southwestern Washington, USA, during winter 2008. In March 2009 we examined five severely affected elk with clinical lameness from this region to characterize hoof lesions, examine the general health of affected elk, and potentially identify etiologies causing hoof disease. Three clinically normal elk from an adjacent but unaffected region were also collected as normal controls. Grossly, affected elk had deformed hooves that were asymmetrical, markedly elongated, and curved or broken, as well as hooves with sloughed horn. Most affected elk had severe sole ulcers with extensive laminar necrosis and pedal osteomyelitis. Histopathology of normal and abnormal hooves identified acute and chronic laminitis in all affected elk and one control elk. Hepatic copper and selenium levels in all affected and control elk were also deficient, and hoof keratin copper levels were low. No significant underlying systemic or musculoskeletal disease was detected in the affected elk, and attempts to isolate bacterial and viral pathogens were unsuccessful. A primary cause of hoof deformity was not definitively identified in this chronically affected group. Studies to identify infectious hoof disease and to characterize acute and subacute lesions are underway.

Key words: *Cervus elaphus roosevelti*, copper deficiency, elk, hoof disease, lameness, laminitis, selenium deficiency, sole ulcer.

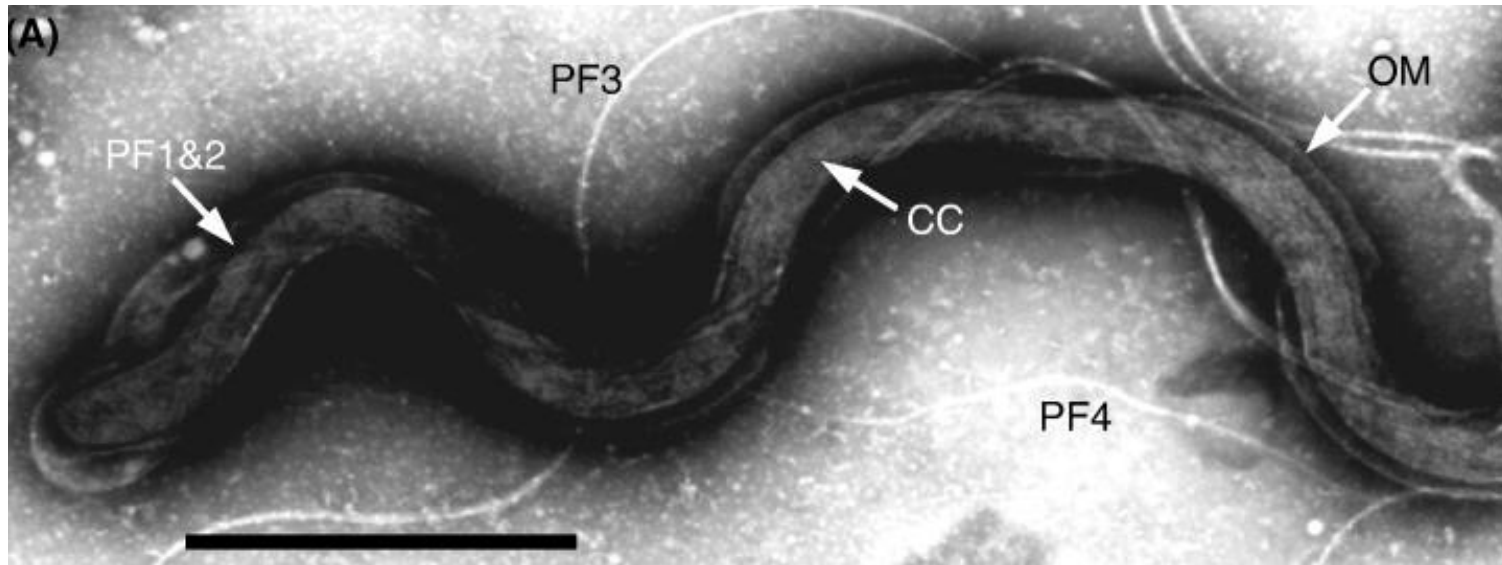
Conclusions

- No significant underlying musculoskeletal or systemic disease
- Disease is limited to the hooves

2013 – 9 month elk



From tooth to hoof: treponemes in tissue-destructive diseases



Treponemes: Spiral shaped bacteria, double membrane, flagella sandwiched between them.

Many innate immunity triggers hidden, thin corkscrew shape facilitates deep tissue penetration.

Most anaerobic (do not use oxygen), slow growth rate, very fastidious, amino acid users, produce volatile fatty acids

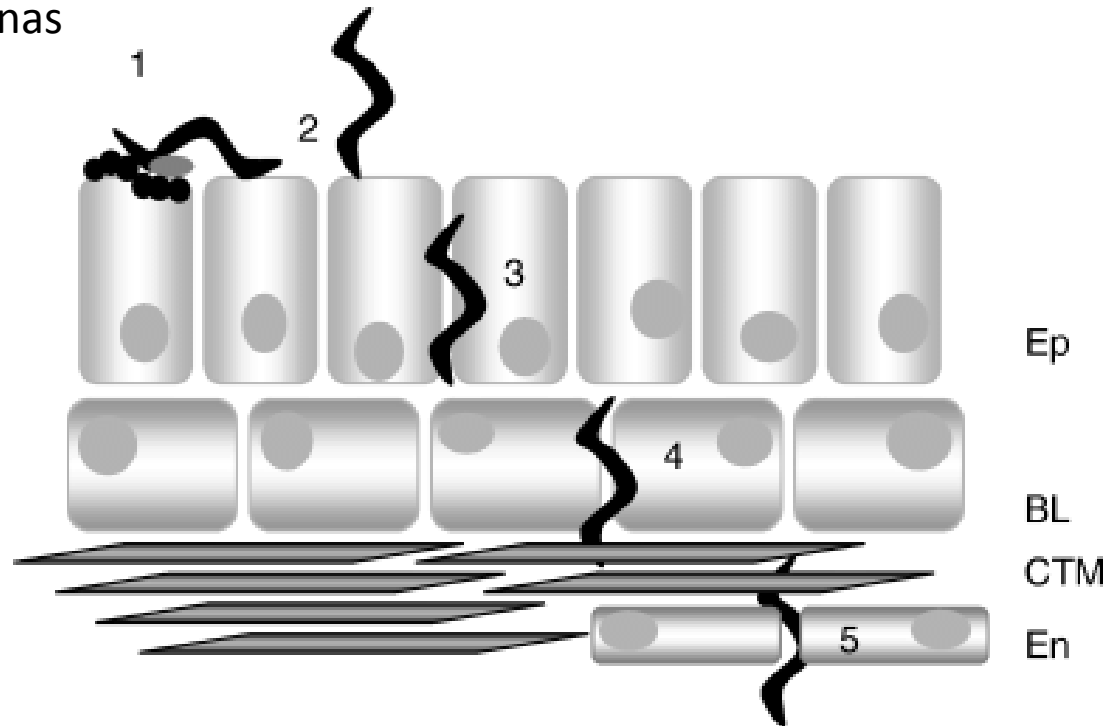
From tooth to hoof: treponemes in tissue-destructive diseases

Similarity to human periodontal disease

Colonization in conjunction with other bacteria: Fusobacterium, Porphyromonas and Streptococcus

Alterations in microenvironment allowing colonization with Treponemes

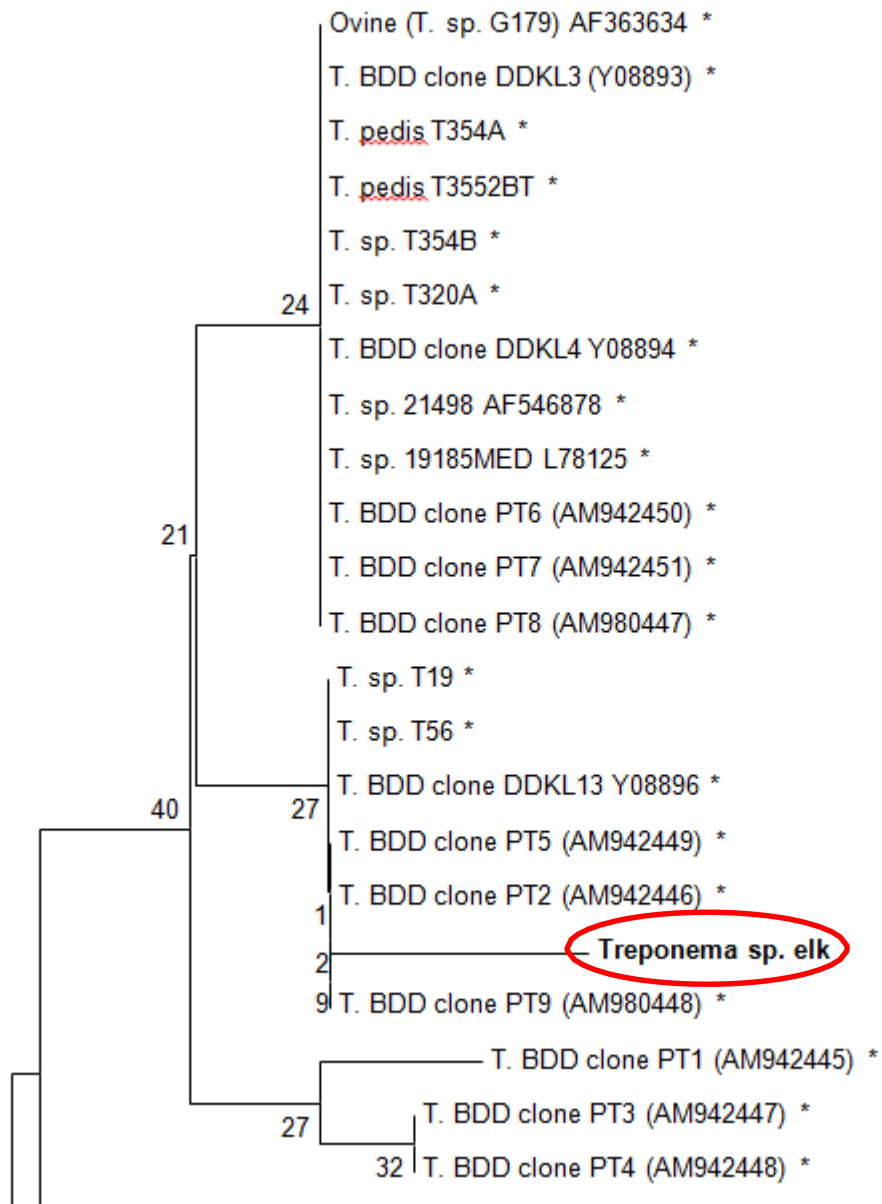
Treponemes have “virulence factors” that allow for deep penetration of epithelial and basal dermal layers



Disease Status and Spirochete Detection

Winter 2013

ELK ID	County	Population Status	Spirochetes in Culture	<i>Treponema</i> sp. PCR	Spirochetes on Histology
001	Pacific	unaffected	ND	neg	neg
002	Pacific	unaffected	ND	neg	neg
003	Pacific	unaffected	ND	neg	neg
004	Kittitas	unaffected	ND	neg	neg
005	Kittitas	unaffected	ND	neg	neg
006	Yakima	unaffected	ND	neg	neg
007	Yakima	unaffected	ND	neg	neg
008	Lewis	affected	pos	pos	pos
009	Lewis	affected	neg	neg	neg
010	Lewis	affected	neg	pos	neg
011	Lewis	affected	neg	neg	pos
012	Lewis	affected	pos	pos	pos
013	Cowlitz	affected	neg	pos	pos
014	Cowlitz	affected	neg	neg	neg
015	Cowlitz	affected	pos	neg	neg
016	Cowlitz	affected	pos	neg	neg



What Do We Know About Digital Dermatitis?

- Emerged as a significant disease of cattle in the US in the mid-1990s
- 2007 NAHMS Survey
 - Present in 70% of dairies nationwide
 - Responsible for 50% of lameness cases within dairies
- Sheep form (CODD) emerged in the UK shortly after cattle form

DD lesions

- Papillomatous digital dermatitis, Hairy heel warts, strawberry warts, Mortellaro disease
- Circular to oval distinct region
- Foul smell
- Hairless, mature lesions can have keratin-like protrusions
- Moist, prone to bleeding when probed
- Extremely painful granular tissue



Identification of Spirochetes Associated with Contagious Ovine Digital Dermatitis[▼]

G. Sayers¹, P. X. Marques¹, N. J. Evans³, L. O'Grady¹, M. L. Doherty¹,
S. D. Carter³ and J. E. Nally^{1,2,*}

+ Author Affiliations

ABSTRACT

Spirochetes of the genus *Treponema* were cultured from 7 of 10 cases of dermatitis in :

Treponema remaining cul medium/*Trepanedenticola*/*Tre*

[Vet J.](#) 2005 Mar;169(2):232-41.

Bovine digital dermatitis and severe virulent ovine foot rot: a common spirochaetal pathogenesis.

[Dhawi A¹](#), [Hart CA](#), [Demirkan I](#), [Davies IH](#), [Carter SD](#).

+ Author information

Abstract

A potential pathological role for spirochaetes in bovine digital dermatitis (bovine DD) and severe virulent ovine foot rot (SVOFR) has been considered and a treponeme isolate obtained from each disease in the UK. In this work, we have investigated the hypothesis that the two diseases may have a shared (common) spirochaetal aetiology. Experiments were designed to identify serological similarities and differences between the two spirochaetes; an enzyme-linked immunosorbent assay (ELISA) was developed to detect anti-treponeme antibodies in the sera of cows and sheep against the two-treponeme isolates. Sera were further tested for antigen reactivity by Western blotting. Cattle and sheep with bovine DD and SVOFR, respectively, had increased seropositivity rates to both treponeme isolates, with different patterns of reactivity between farms. In some cattle herds, significant correlations were shown between antibodies to bovine DD treponemes and SVOFR treponemes ($P < 0.001$). In other herds, there was no apparent cross reaction, suggesting the presence of more than one treponeme in bovine DD on some farms. There was no significant correlation between the two treponeme isolates when ELISA-tested against 58 sheep sera from SVOFR cases ($P > 0.05$); sheep showed strong evidence of reactivity to one or the other treponeme antigens, but never to both. Western blotting against both treponeme antigens showed that they frequently displayed different antigen epitopes, although some minor bands were common to both organisms. The data suggest that there are a number of spirochaetes in UK farms, which could be involved in the pathogenesis of either bovine DD or SVOFR.

Isolation and characterisation of a novel spirochaete from severe virulent ovine foot rot

I. DEMIRKAN, S. D. CARTER, C. WINSTANLEY*, K. D. BRUCE†, N. M. McNAIR‡, M. WOODSIDE§ and C. A. HART*

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A novel spirochaete was isolated from a case of severe virulent ovine foot rot (SVOFR) by immunomagnetic separation with beads coated with polyclonal anti-treponemal antisera and prolonged anaerobic broth culture. The as yet unnamed treponeme differs considerably from the only other spirochaete isolated from ovine foot rot as regards morphology, enzymic profile and 16S rDNA sequence. On the basis of 16S rDNA, it was most closely related to another unnamed spirochaete isolated from cases of bovine digital dermatitis in the USA, raising the possibility of cross-species transmission. Further information is required to establish this novel ovine spirochaete as the cause of

2014 – EL-14-002

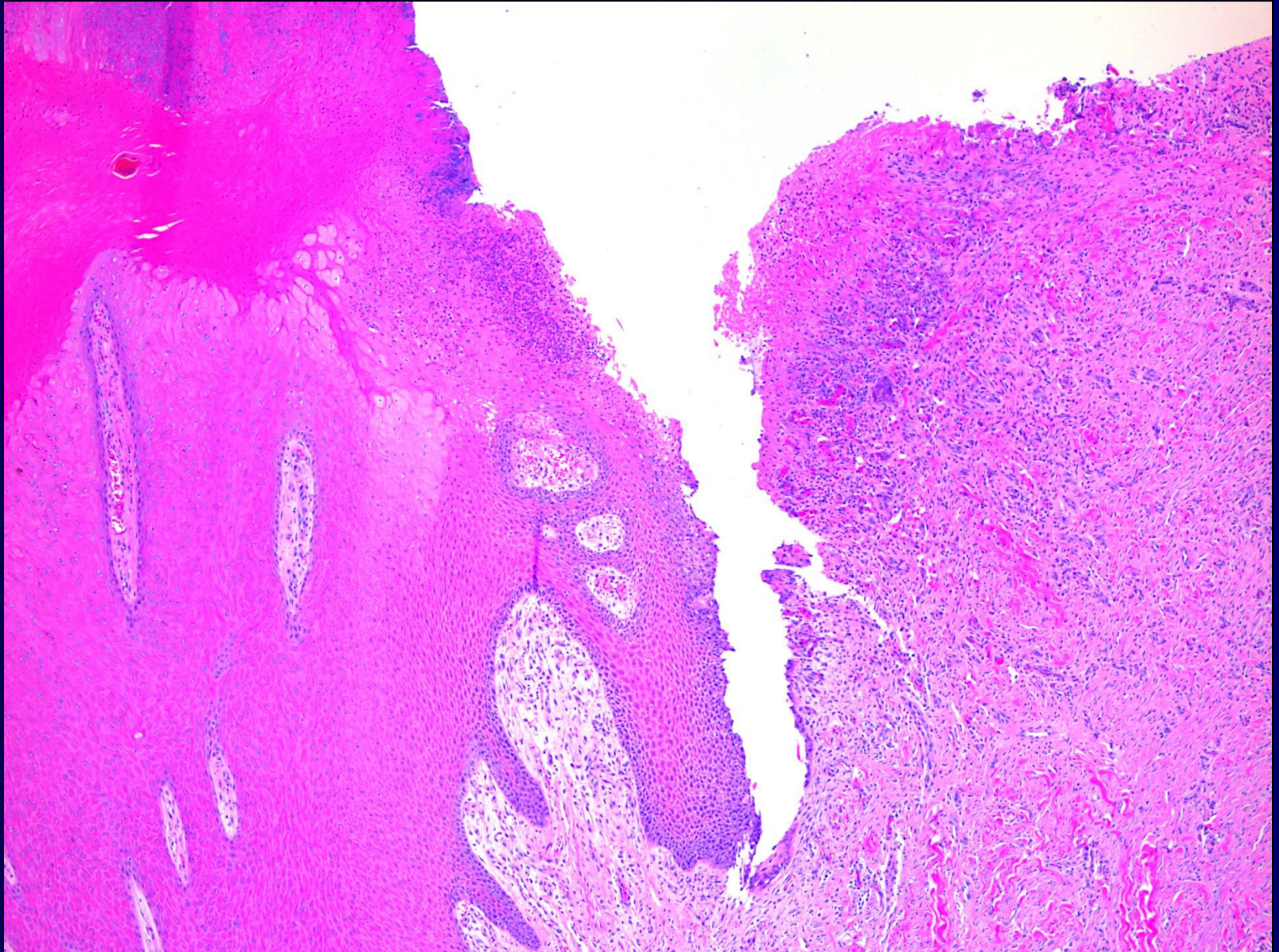
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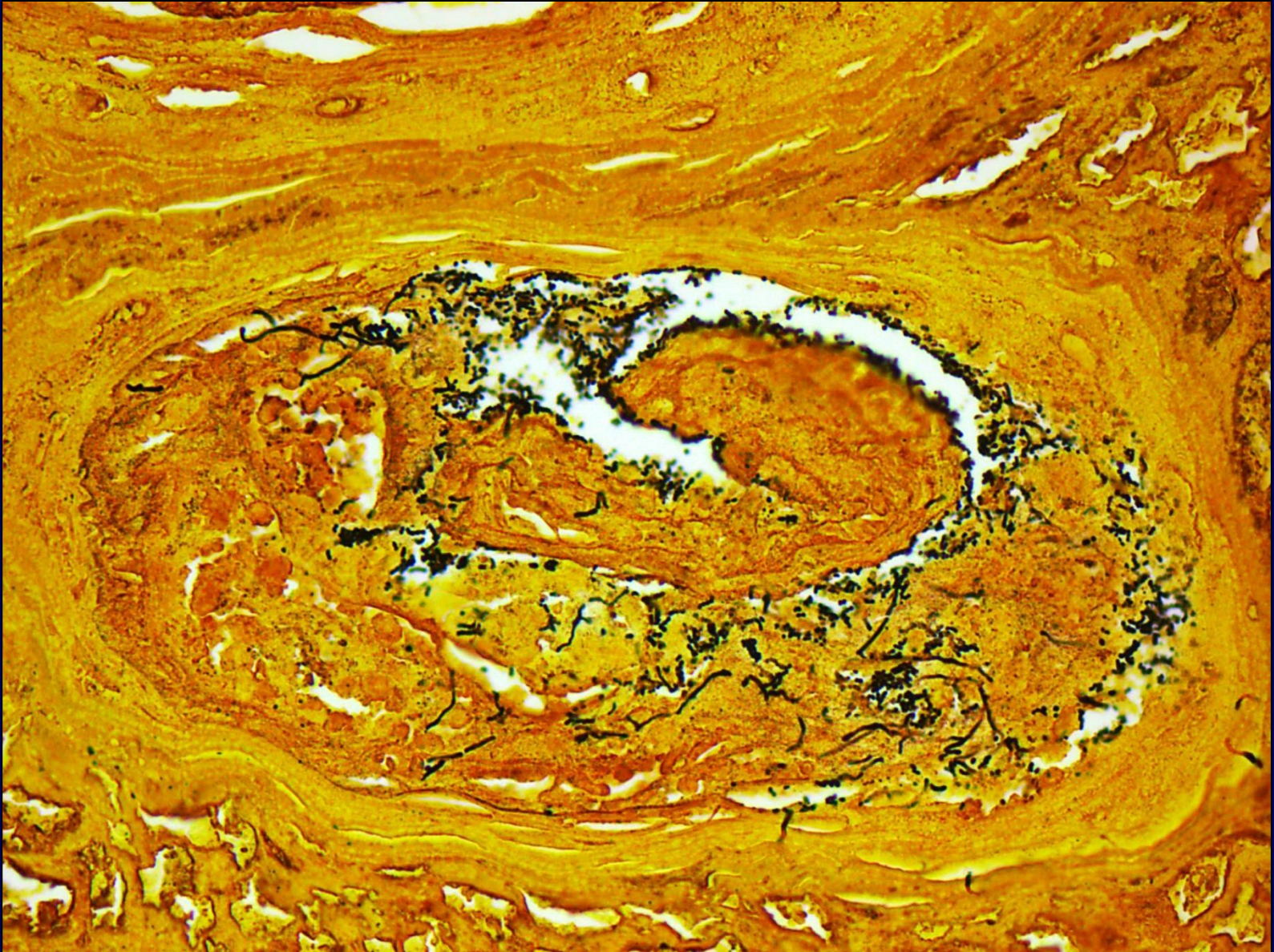


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CODD vs. Elk Hoof Disease



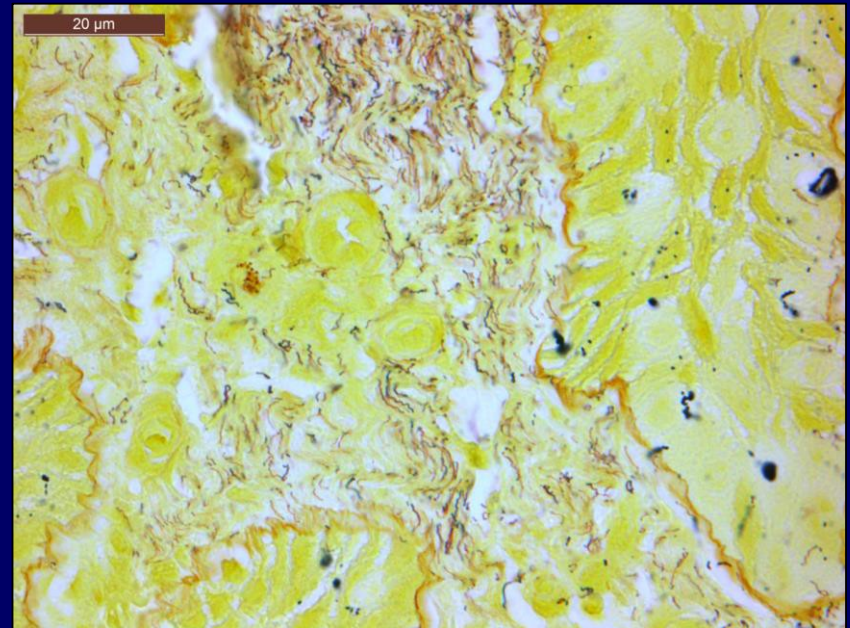
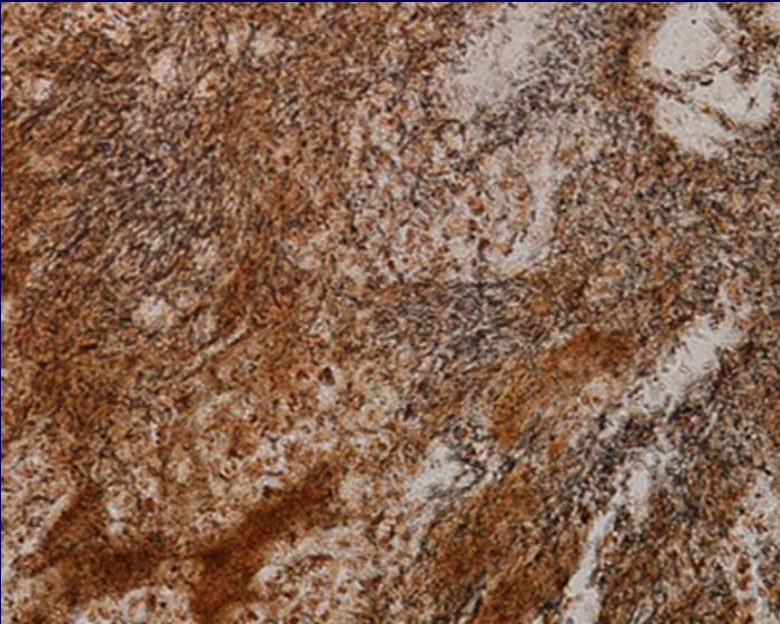
CODD vs. Elk Hoof Disease



CODD vs. Elk Hoof Disease



CODD vs. Elk Hoof Disease



CODD of Domestic Sheep



A herd of elk is running across a rocky, snow-dusted landscape. The elk are in the foreground, moving from left to right. The background features a large, forested mountain range under a clear blue sky. The word "Questions?" is overlaid in large black text in the center of the image.

Questions?

Photo by Nicholle Stephens