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Bovine Respiratory Disease Complex
Coordinated Agriculture Project

http://www.brdcomplex.org

UPDATE
Integrated Program for Reducing Bovine Respiratory Disease Complex in Beef and Dairy Cattle

Project Director
James Womack (TAMU)

Genome Association Studies

Chris Seabury (TAMU), Jerry Taylor (Missouri), Holly Neibergs (WSU)

Objective: Identify genomic regions associated with BRDC resistance/susceptibility in beef and dairy cattle.

- Reference populations encompassing 6000 animals
  - Pre-weaned dairy calves and replacement heifers
  - Crossbred feedlot cattle
  - Beef cattle in GrowSafe systems
  - Pathogens characterized for each diagnosis

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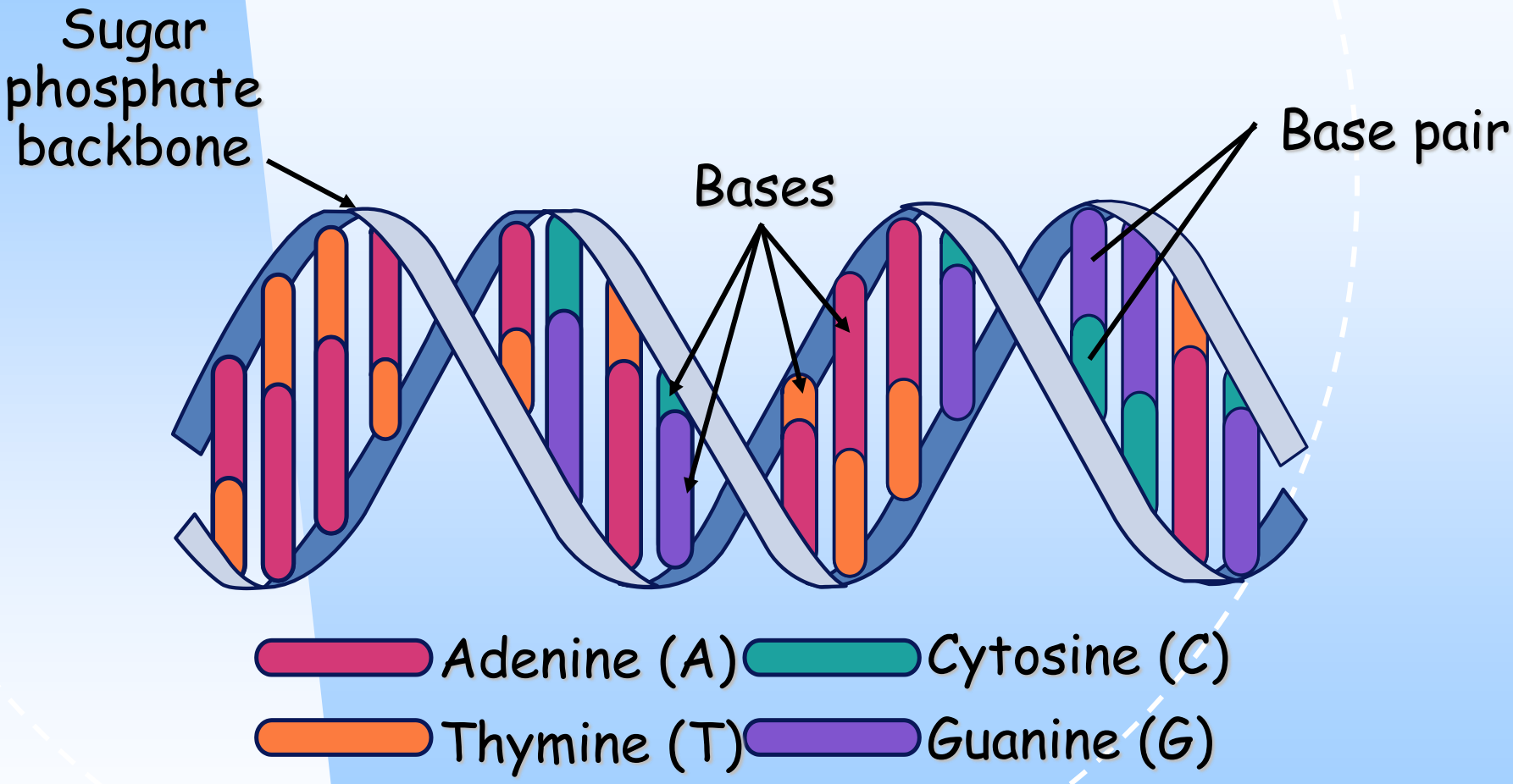
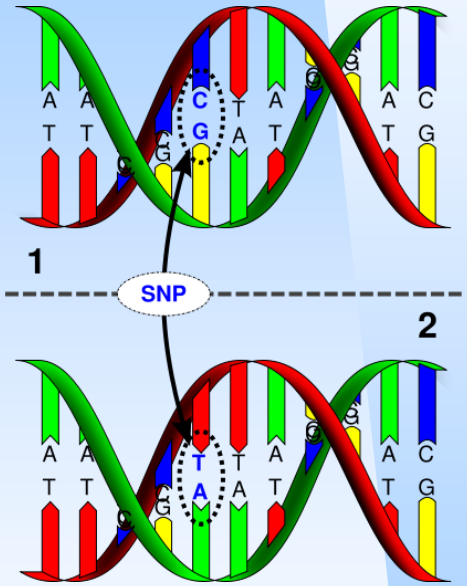
DNA



Associations of DNA with Disease



- Identify SNPs that are found in diseased animals but not in healthy animals
- Allows us to select animals that are less likely to get sick
- When the whole genome is evaluated = GWAS

Dairy Cattle Study

- **California**
  - UC Davis Veterinary Medical Teaching and Research Center, Tulare collected samples and diagnosed calves at 80,000 calf facility
- **New Mexico**
  - New Mexico State University and Southern Great Plains Dairy Consortium collected samples and diagnosed calves at 3 dairies at Clovis

Diagnostics

SCHOOL OF VETERINARY MEDICINE
University of Wisconsin-Madison

Calf Health Scoring Criteria			
0	1	2	3
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
			
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
			
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
			

S. McGuirk's Diagnostic Criteria

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Veterinary Medical Teaching and Research Center at Tulare, CA

- Terry Lehenbauer
- Sharif Aly
- Jessica Davis (Veterinary Intern)
- Paul Rossitto
- Kandi Gist

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California Dairy Calves

- Samples on 2031 calves between 30 and 70 days of age collected and clinical scores obtained
- Diagnostics for Mycoplasma, *P. multocida, M. haemolytica, H. somni,* bovine respiratory syncytial virus, bovine viral diarrhea virus, IBR completed
- DNA extracted, and genotyped for 778,000 SNPs

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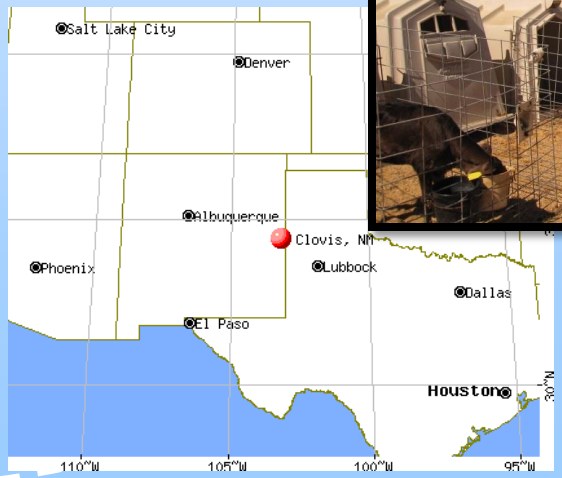
784 Replacement Heifers
New Mexico State University

- Milton Thomas (now at CSU)
- Robert Hagevoort
- Tim Ross
- Erik Chavez



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Beef Feedlot Study

WSU Coordinating

- 1000 beef (Bos taurus) animals (500 cases and 500 controls) completed in Colorado
- Another 1000 beef feedlot study ongoing in Washington
- Same diagnostic criteria and diagnostic swabs as dairy calves
- Followed through processing
- Genotypes to be completed next year

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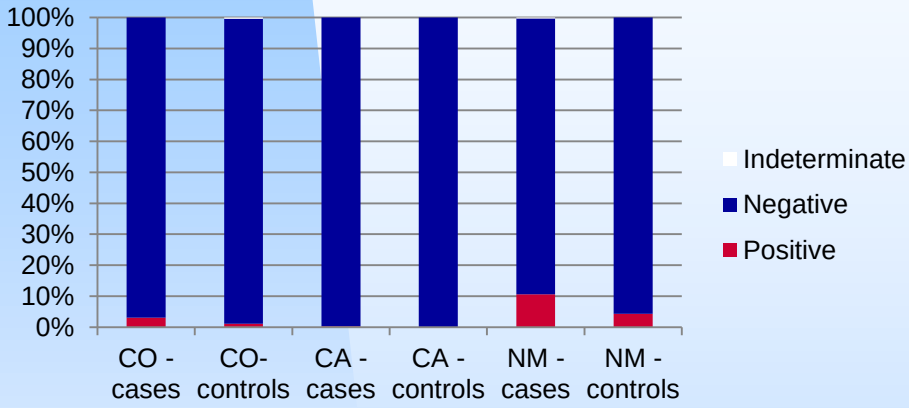
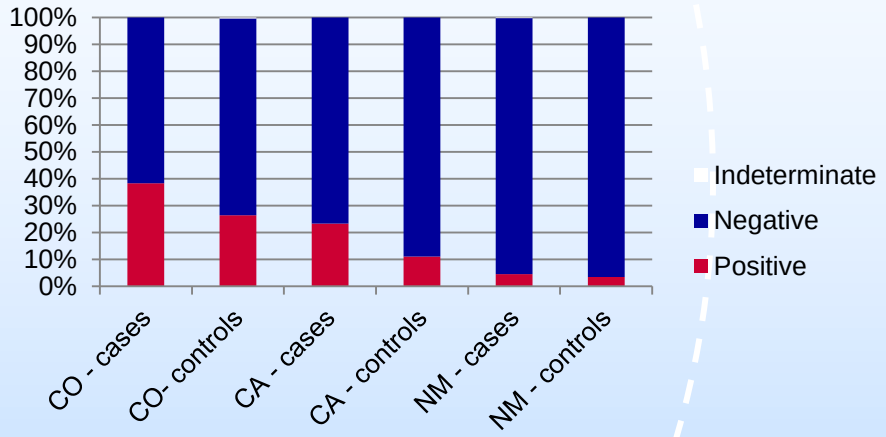
Diagnostics

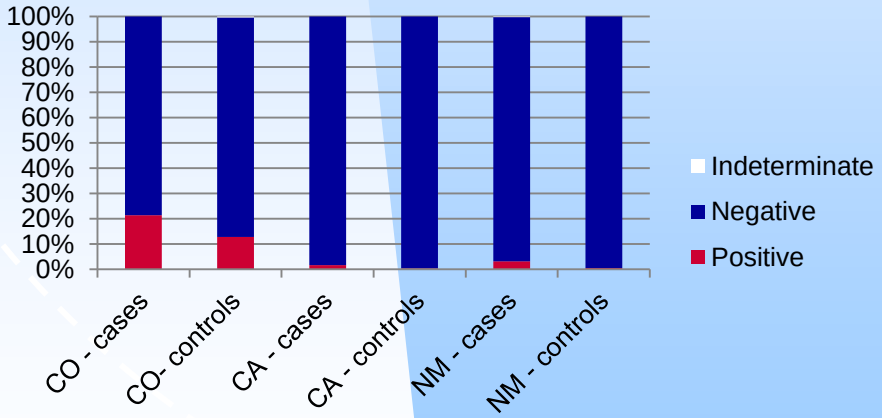
Arcanobacterium



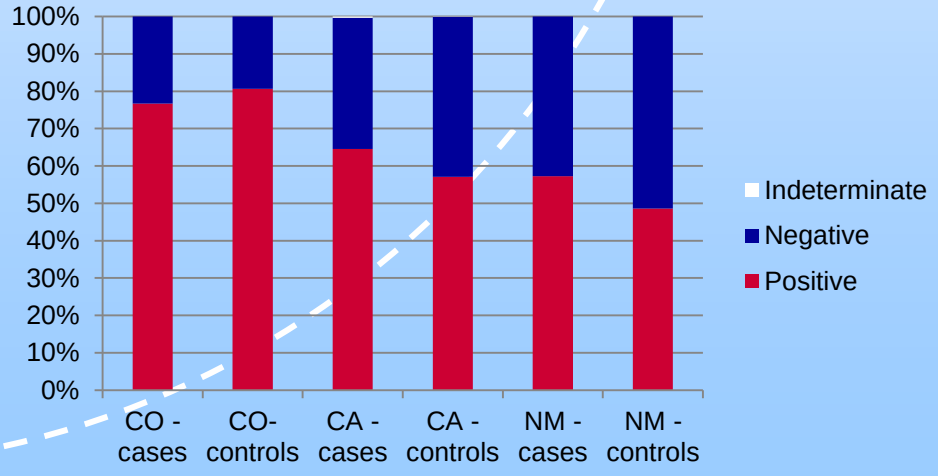
Mannheimia haemolytica



Histophilus somni



Mycoplasma bovis



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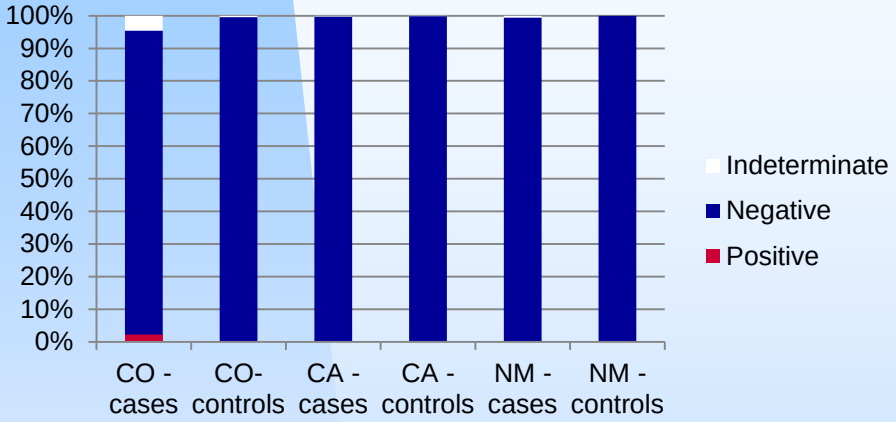
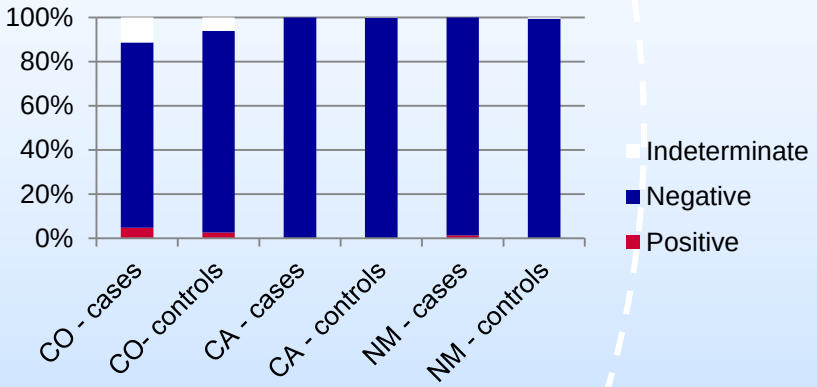
Diagnostics

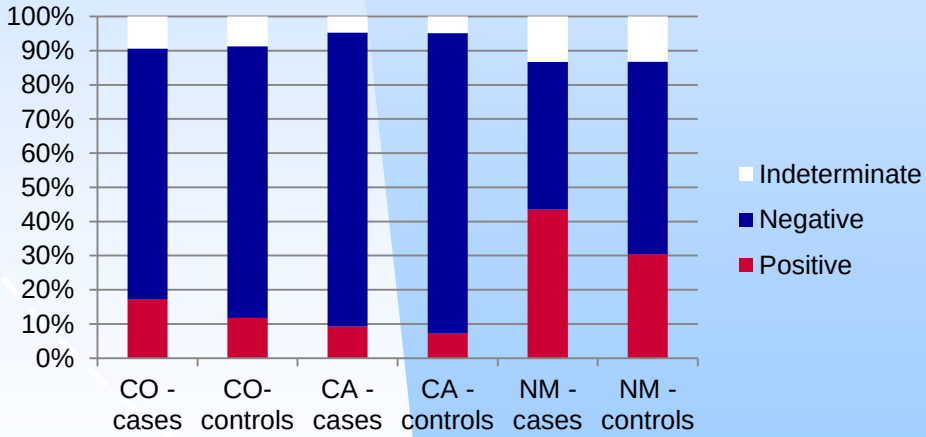
Infectious Bovine Rhinotracheitis



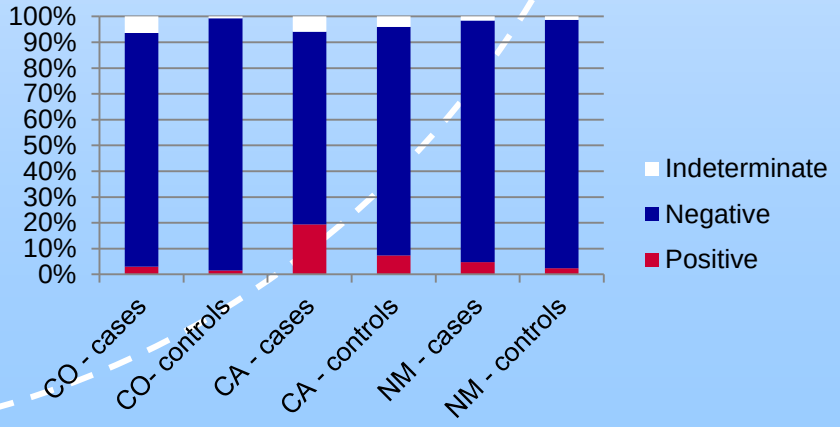
Bovine Viral Diarrhea Virus



Bovine Corona Virus



Bovine Respiratory Synctial Virus



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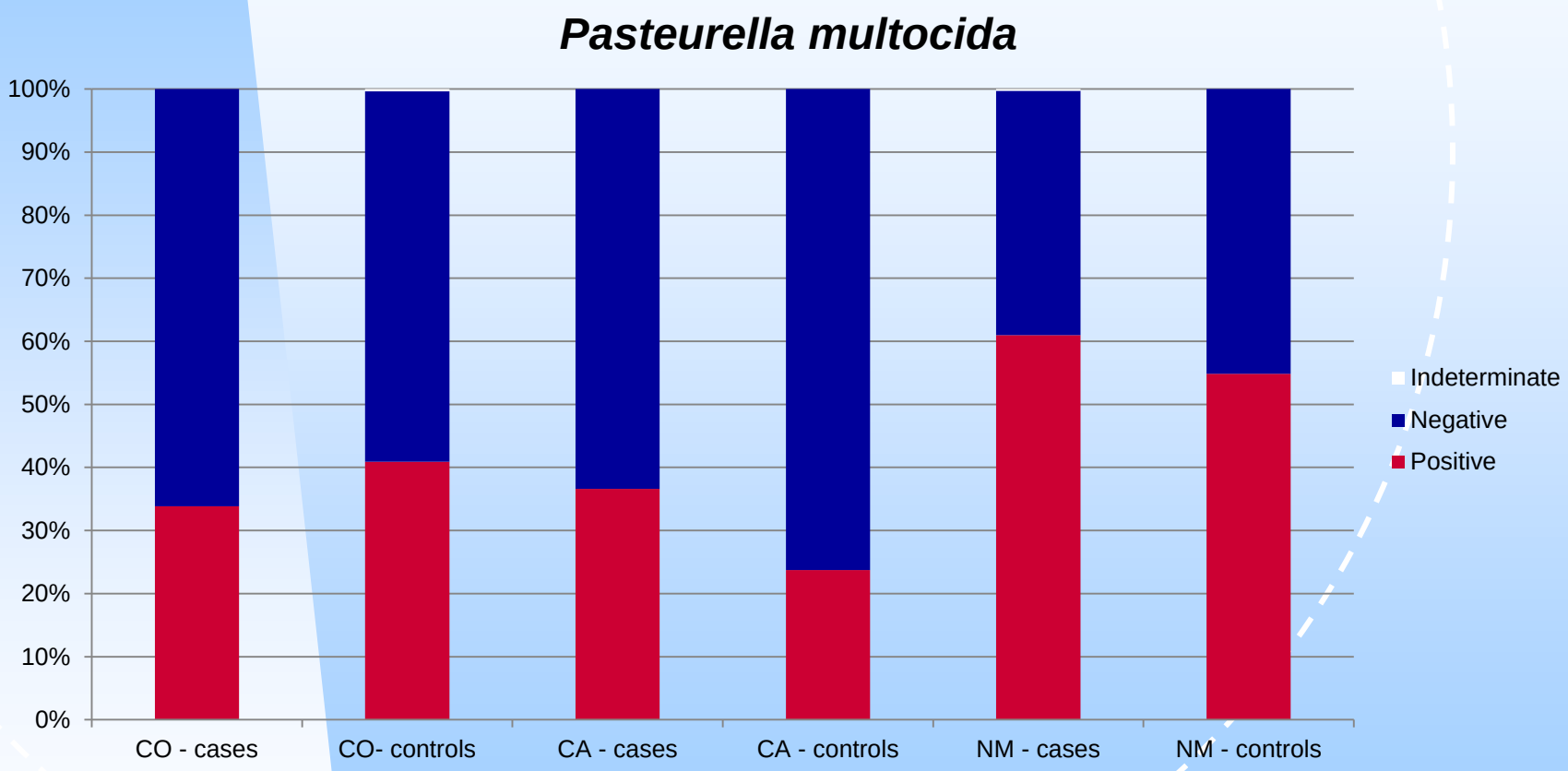
Diagnostics

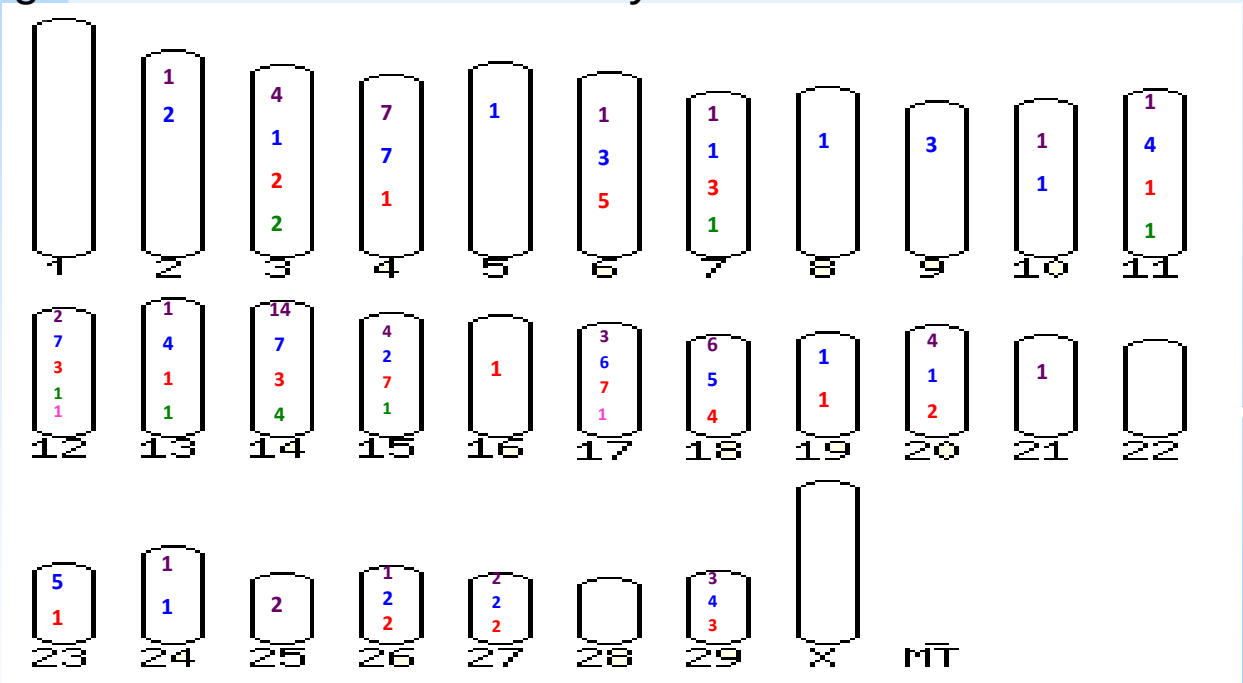


BRD Pathogens in Dairy

Pathogen	Prevalence CA % Cases (%Controls) N=2031	Prevalence NM % Cases (%Controls) N=767	Odds Ratio	95% Confidence Interval	Significance
Arcanobacterium pyogenes	10.6 (4.3)	0.3 (0)	2.8	1.5-4.9	0.006
Histophilus somni	1.7 (0.4)	3.2 (0.5)	4.9	2.0-11.5	0.0004
Manheimia haemolytica	25.4 (11.1)	4.5 (3.5)	2.3	1.8-2.8	<0.001
Pasteurella multocida	36.6 (23.7)	61 (54.8)	1.4	1.2-1.7	<0.0001
Mycoplasma spp.	64.6 (57.1)	57.3 (48.7)	1.4	1.2-1.6	0.0001
Bovine corona virus	9.2 (7.4)	43.5 (30.4)	1.5	1.2-1.8	0.0003
Bovine respiratory syncytial virus	19.4 (7.4)	4.8 (2.4)	2.9	2.3-3.8	<0.0001

Summary CA and NM BRDC Case Control

Ranking of all SNPs (4 analyses) with Combined California and New Mexico case/control data identified 59 genomic regions shared by all 4 analyses and 164 regions shared by 3 analyses. The number within the chromosomes represents the number of regions associated across analyses on that chromosome.



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Legend: Purple=Common to all analyses, Blue=Common to PLINK, GBLUP and EMMAX, Red=Common to GBLUP, FvR and EMMAX, Green=Common to PLINK, GBLUP and FvR, Pink=Common to PLINK, FvR and EMMAX

Animal Welfare

- **Objective: Assess how animal welfare is affected by BRDC in cattle.**
- UC Davis: Cassandra Tucker, Aldroaldo Zanella, Laurel Gershwin, Alison Van Eenennaam




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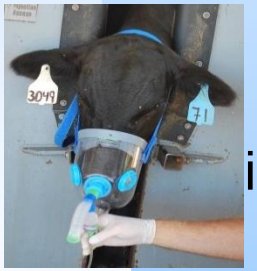
4 treatments (13 steers/each):

- BRD
- BRD+meloxicam
- Healthy
- Healthy+meloxicam

2011 Timeline

day -7

move into individual pens



infect with BRSV

day 0

day 5

infect with *H. somni*

treatment

day 8

day 13

return to herd; monitored for 1 additional week

Rachael Toaff-Rosenstein

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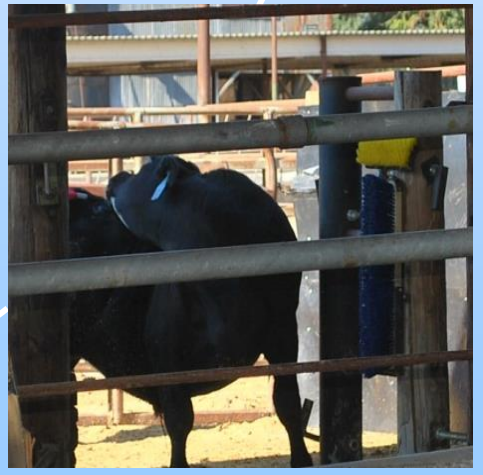
Behavior Study 2012
UC Davis

- Evaluate environmental enrichment as a means of improving morbidity and detection of sickness as measured by grooming behavior
- Piggy-backed on challenge study



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2012 Behavior Study

- All animals in the challenged study used (except BVDV)
- Grooming and self-licking assessed 20 min/d; feed intake, body temperature, lying behavior assessed continuously with a data logger for 8 days
- Data collected for bunk attendance from video and 1776 hours viewed
- >1000 hours of brush-grooming video viewed

Challenge Studies

- **Objective: Identify the interaction of the cattle genome with the pathogens responsible for BRDC**
  - UC Davis: Laurel Gershwin, Alison Van Eenennaam,

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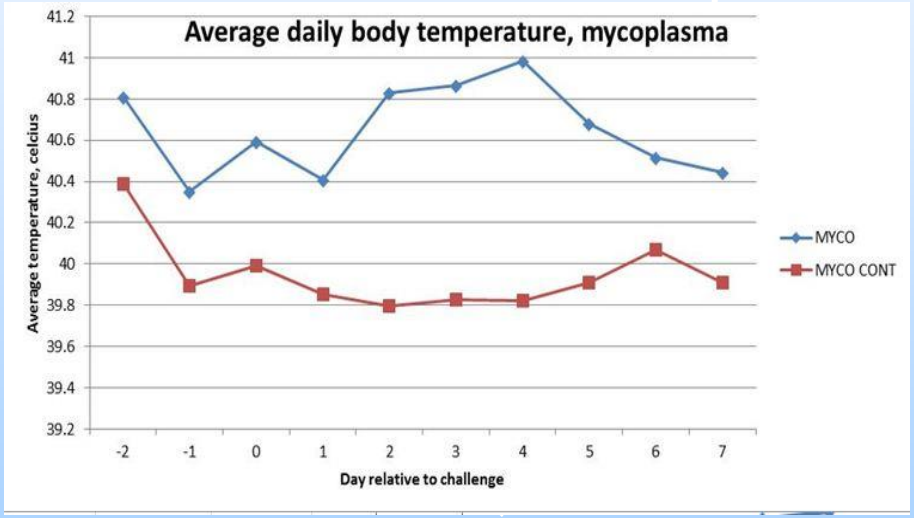
Challenge Study
UC Davis 2011-12

- 300 kg Angus calves challenged with *Mycoplasma bovis*, *P. multocida, M. haemolytica,* bovine viral diarrhea virus, and bovine respiratory syncytial virus
- Identify genes expressed with given pathogens by sequencing transcripts (RNA-seq) of bronchia-alveolar lymph nodes
- Characterize immunological responses

Pathogen Challenges

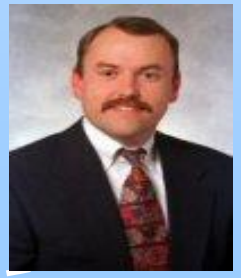
- **Challenge studies have provided:**
  - BRSV, n = 6
  - IBR, n = 6
  - BVDV, n = 6
  - *M .hemolytica*, n = 6
  - *P. multocida*, n = 2
  - *H. somni*, n = 2
  - *M. bovis*, n = 4
- **RNA-seq ongoing**



Economics

Shannon Neibergs (WSU), David Anderson (TAMU)

- Determine economic cost of BRDC to dairies and feedlots and develop stochastic bio-economic models for the cost-benefit of strategies for reducing BRD
  - Financial data collected and model developed for dairy calves
  - Close out data not yet obtained from Colorado feedlot as not all animals have been processed



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Extension

Alison Van Eenennaam Coordinator (UC Davis),
Shannon Neibergs (WSU)

- Develop and deliver educational programs on best management practices integrating economics, animal health management, genomic, and animal breeding approaches to reduce BRDC
  - Too many things to name!
  - Please visit website **http://www.brdcomplex.org**

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Education

Robert Hagevoort (NMSU), Mark Enns (CSU), Milton Thomas (CSU)

- Provide instruction on management, identification and treatment of BRDC at Southern Great Plains Dairy Consortium
- Provide funds and internships for undergraduate and graduate research
- Develop interactive 4-H games and test at regional fairs

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Education

- Provide national distance learning course on the integration of animal health managements with genomic and animal breeding approaches to reduce livestock disease
  - “Animal health management and genetic approaches to disease”
  - “Genetic Improvement of BRDC Resistance”

- Sponsor undergraduate and graduate students to attend Southern Great Plains Dairy Consortium

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