Bedding strategies that promote udder health and milk quality by fostering a beneficial microbiome on organic dairy farms

A research and extension project funded by the USDA Organic Research and Extension Initiative

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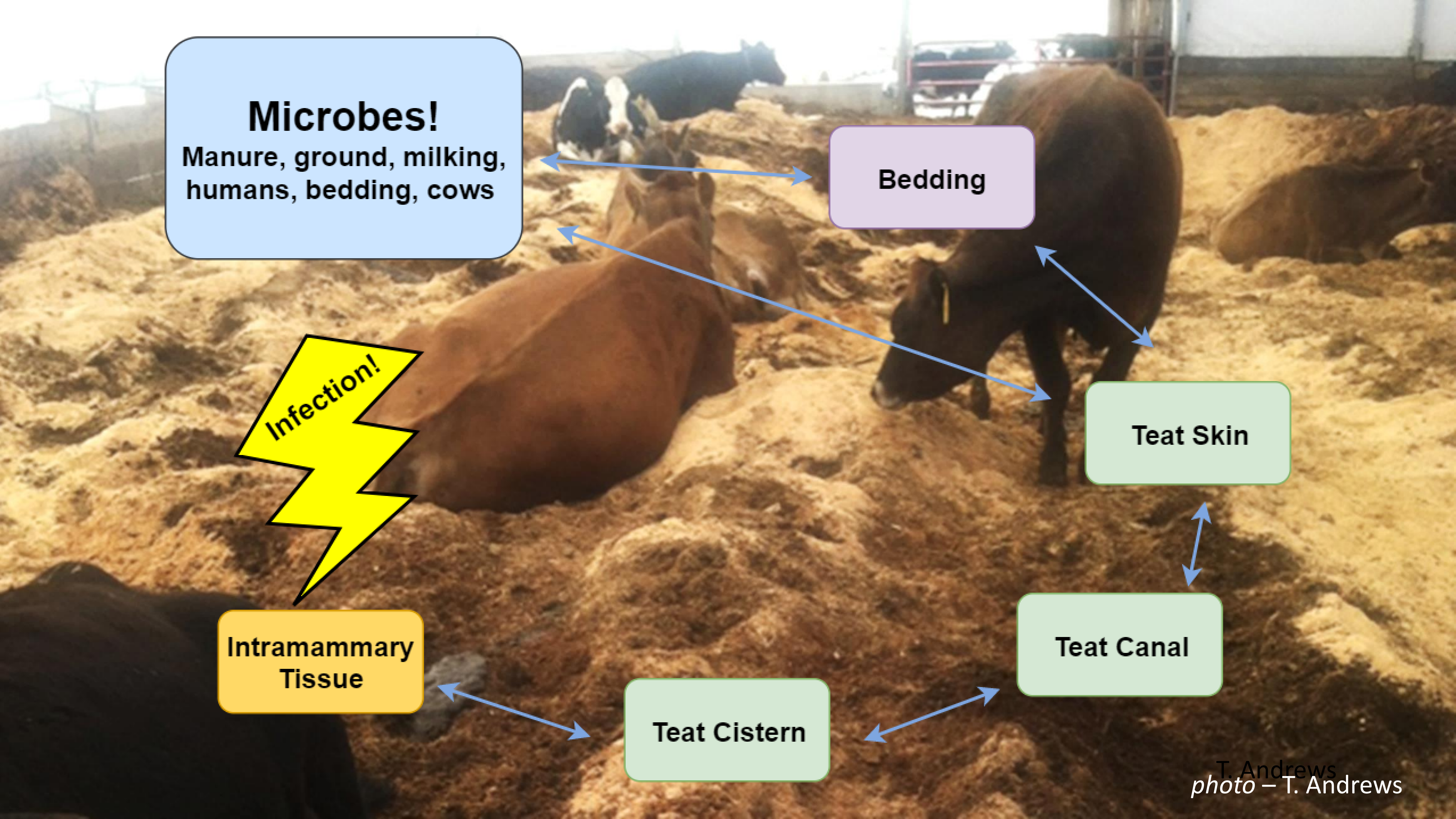


Microbes!

Manure, ground, milking, humans, bedding, cows

Bedding

Teat Skin

Teat Canal

Teat Cistern

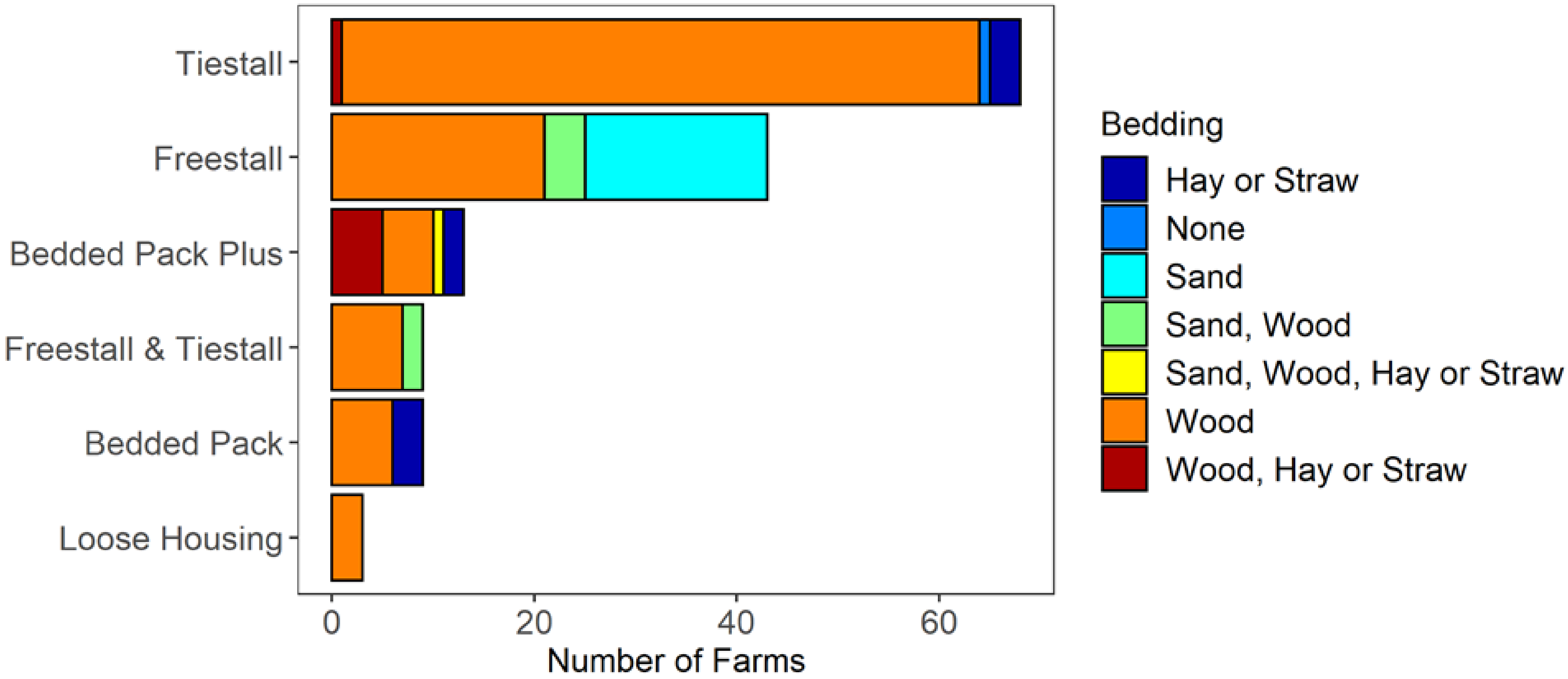
Intramammary Tissue

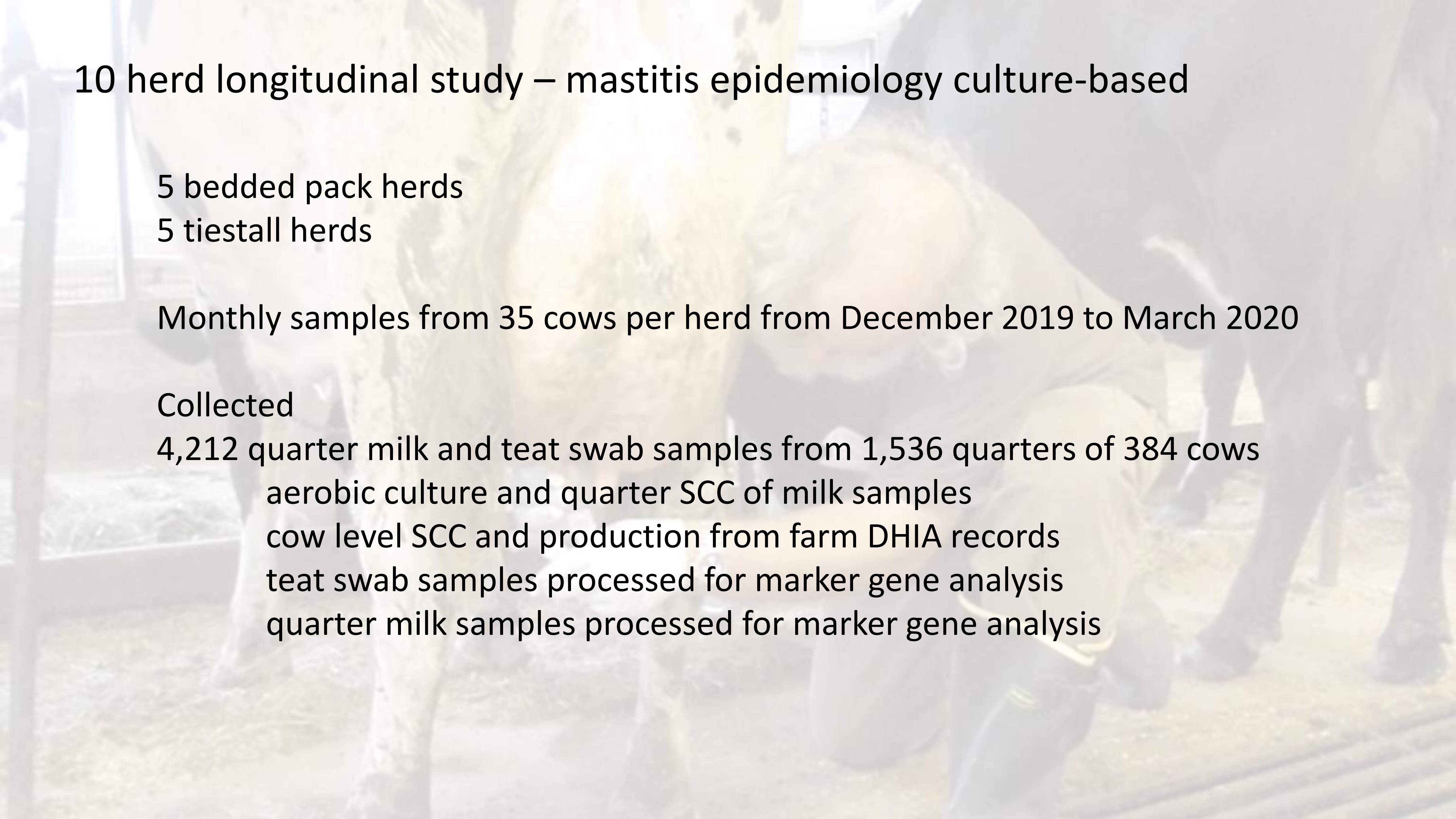
Infection!

T. Andrews

photo – T. Andrews

“Survey design and implementation quantifies winter housing and bedding types used on Vermont organic dairy farms” Dairy industry Today, J Dairy Sci





10 herd longitudinal study – mastitis epidemiology culture-based

5 bedded pack herds
5 tiestall herds

Monthly samples from 35 cows per herd from December 2019 to March 2020

Collected
4,212 quarter milk and teat swab samples from 1,536 quarters of 384 cows
- aerobic culture and quarter SCC of milk samples
- cow level SCC and production from farm DHIA records
- teat swab samples processed for marker gene analysis
- quarter milk samples processed for marker gene analysis

10 herd longitudinal study – mastitis epidemiology culture-based

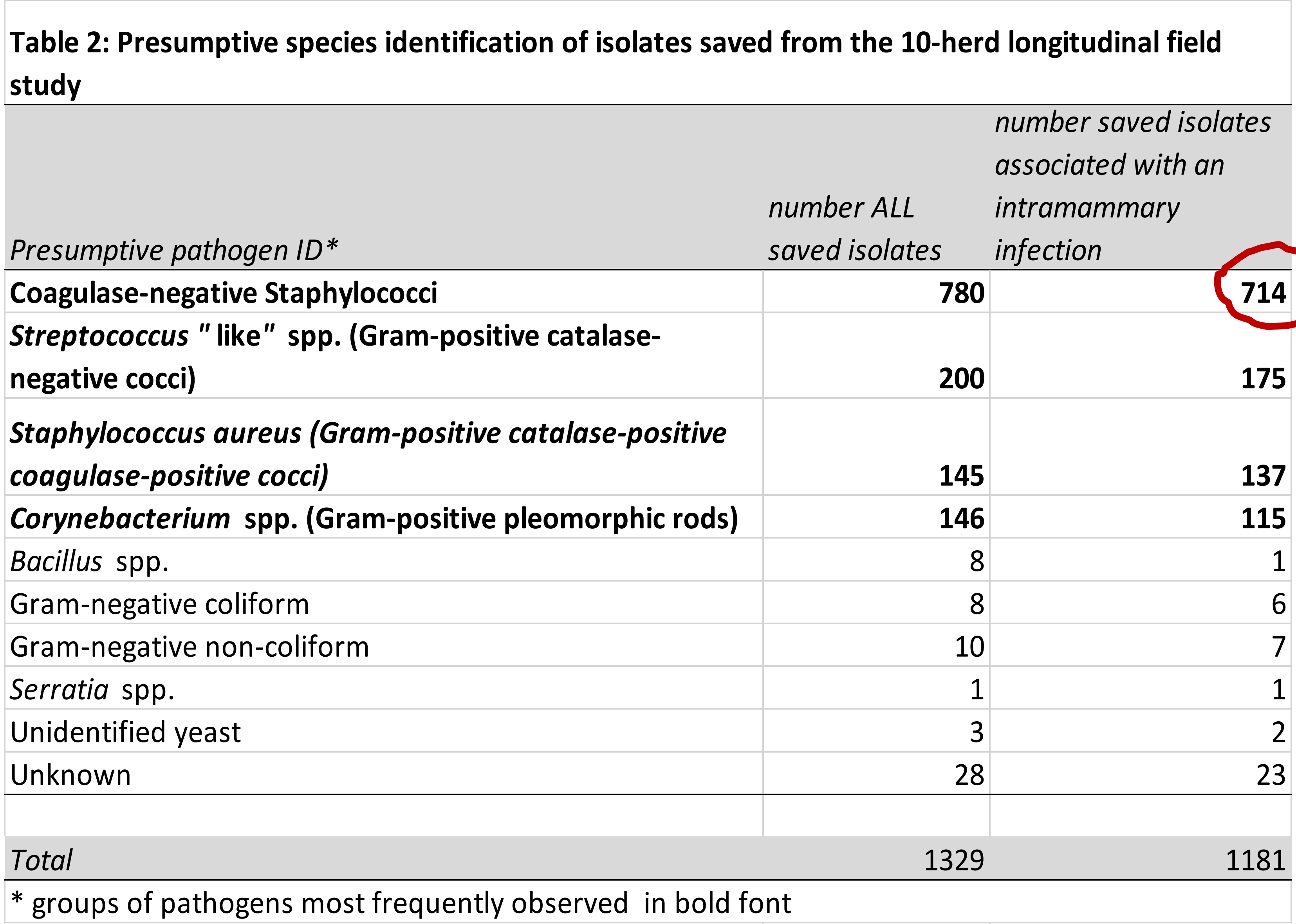


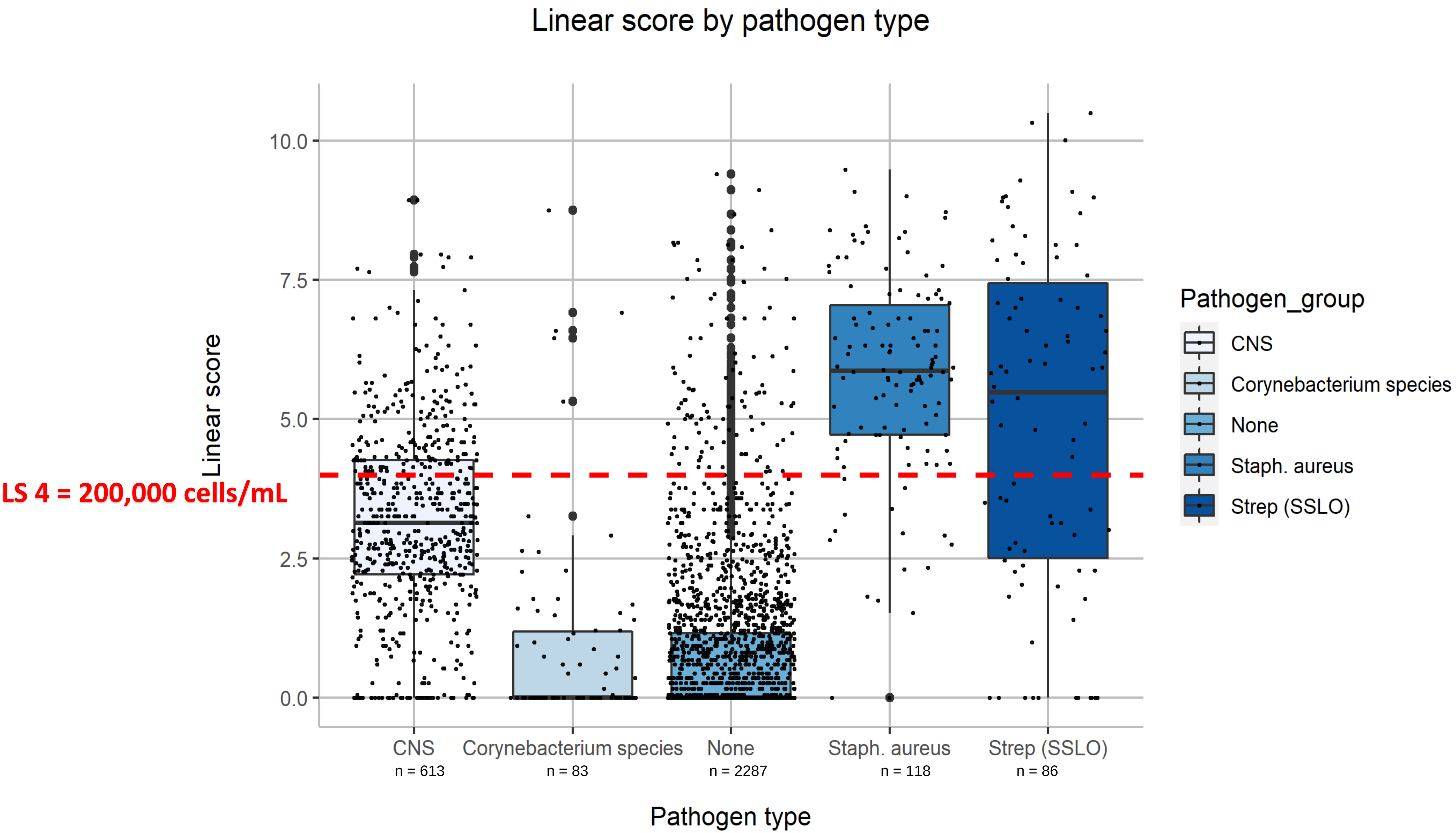
Table 2: Presumptive species identification of isolates saved from the 10-herd longitudinal field study

*Presumptive pathogen ID**	*number ALL saved isolates*	*number saved isolates associated with an intramammary infection*
Coagulase-negative Staphylococci	**780**	**714**
***Streptococcus* " like" spp. (Gram-positive catalase-negative cocci)**	**200**	**175**
Staphylococcus aureus (Gram-positive catalase-positive coagulase-positive cocci)	**145**	**137**
***Corynebacterium* spp. (Gram-positive pleomorphic rods)**	**146**	**115**
Bacillus spp.	8	1
Gram-negative coliform	8	6
Gram-negative non-coliform	10	7
Serratia spp.	1	1
Unidentified yeast	3	2
Unknown	28	23
Total	1329	1181

* groups of pathogens most frequently observed in bold font

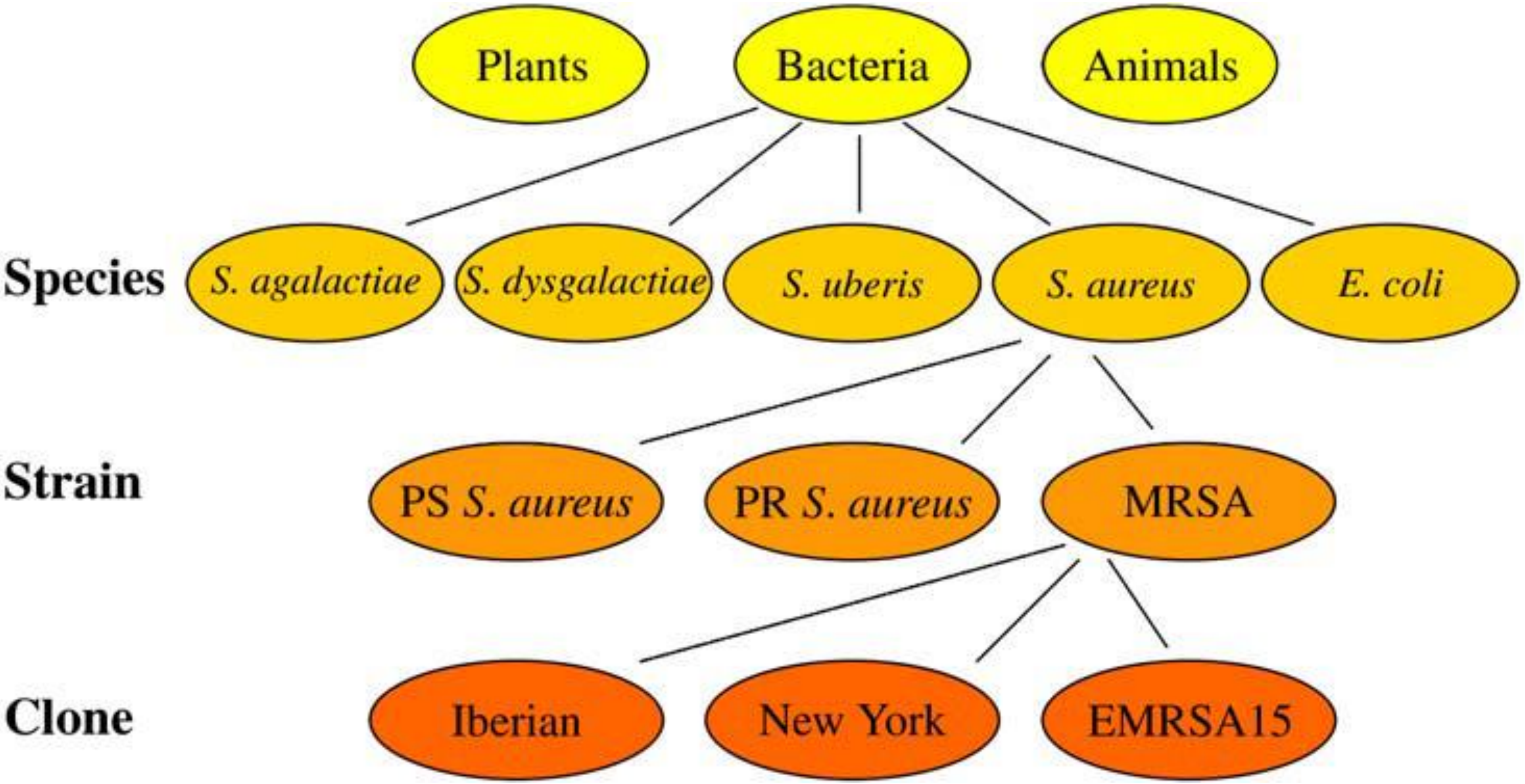
60% of isolates from infections are non-aureus Staphylococci

Species identification ongoing with Dr. Pamela Adkins at U of Missouri



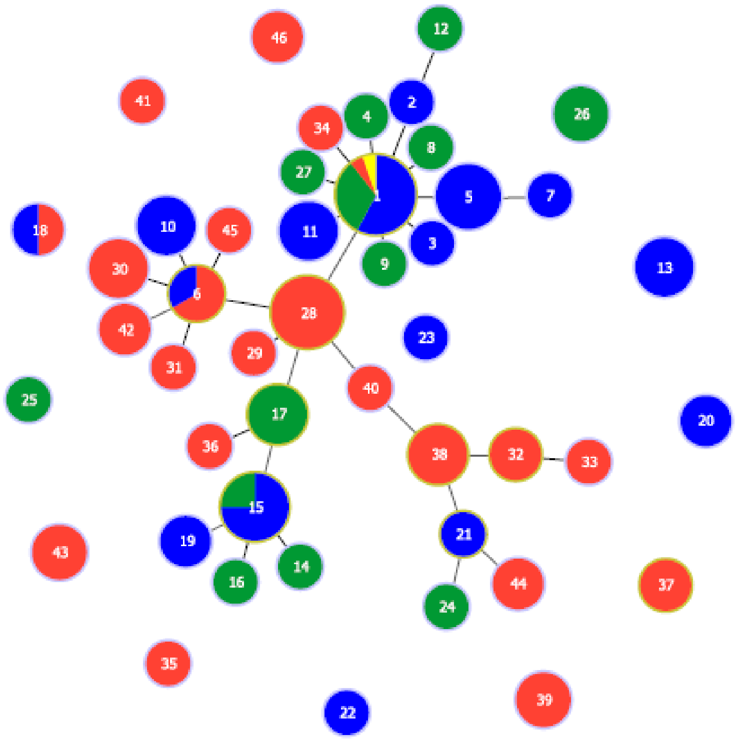
Linear score by pathogen type

LS 4 = 200,000 cells/mL



From Zadoks and Schukken 2006

PLOS ONE



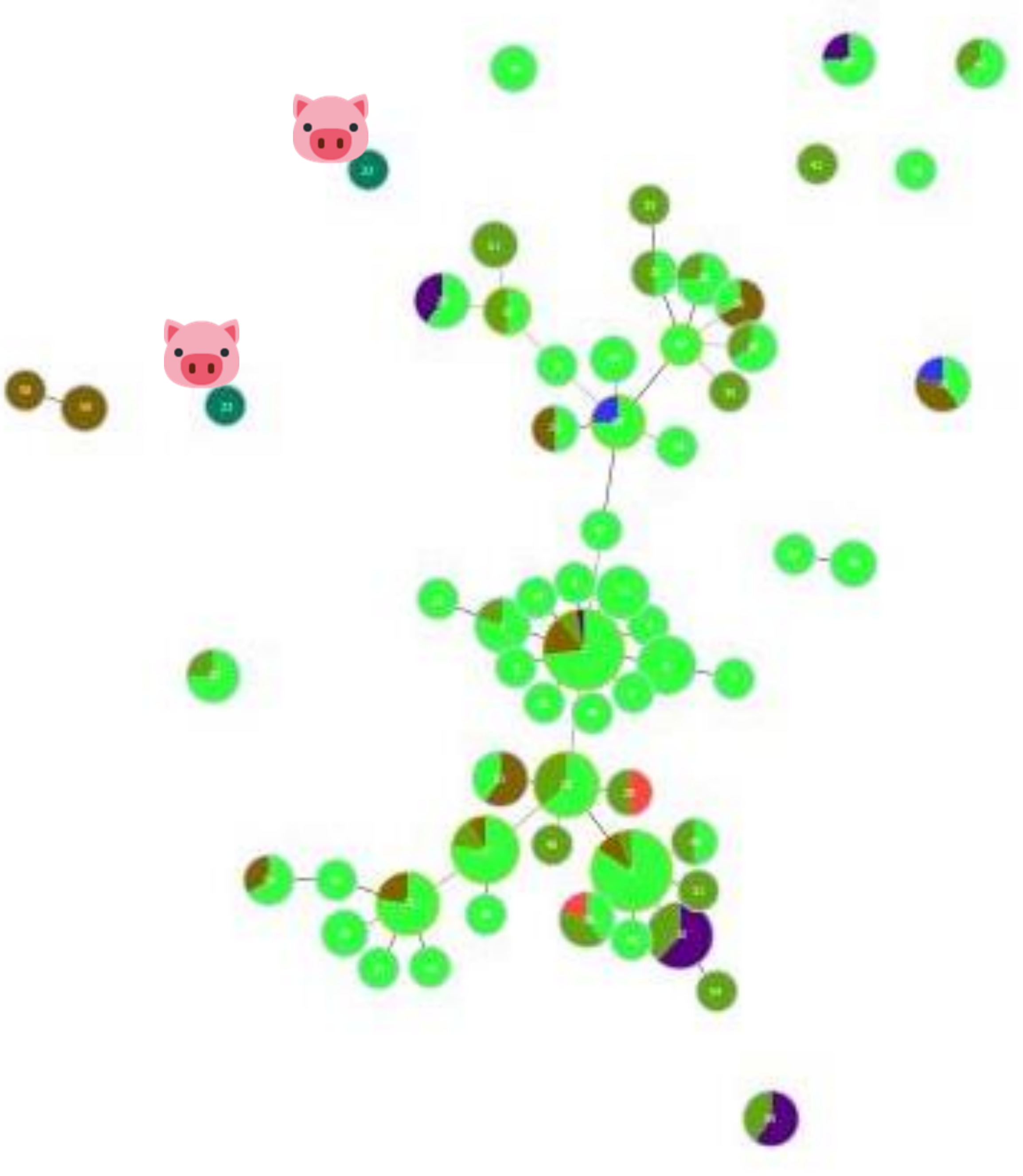
RESEARCH ARTICLE

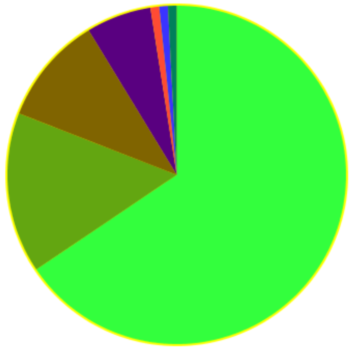
Characterization of genetic diversity and population structure within *Staphylococcus chromogenes* by multilocus sequence typing

Rebeca Huebner[1], Robert Mugabi[2¤a], Gabriella Hetesy[2¤b], Lawrence Fox[3], Sarne De Vliegher[4], Anneleen De Visscher[4¤c], John W. Barlow[2*], George Sensabaugh[1]

70% of non-aureus Staphylococci isolates from our current study are *Staphylococcus chromogenes*

Sources





🟩 Cow IMI (n=158, 66%)

🟩 Teat skin (n=137, 15%)

🟫 Milking System (n=25, 10%)

🟪 Other cow skin (n=15, 6%)

🟥 Barn environment (n=2, 1%)

🟦 Cheese (n=2, 1%)

🟩 Pigs (n=2, 1%)

10 herd longitudinal study – mastitis epidemiology marker gene experiments

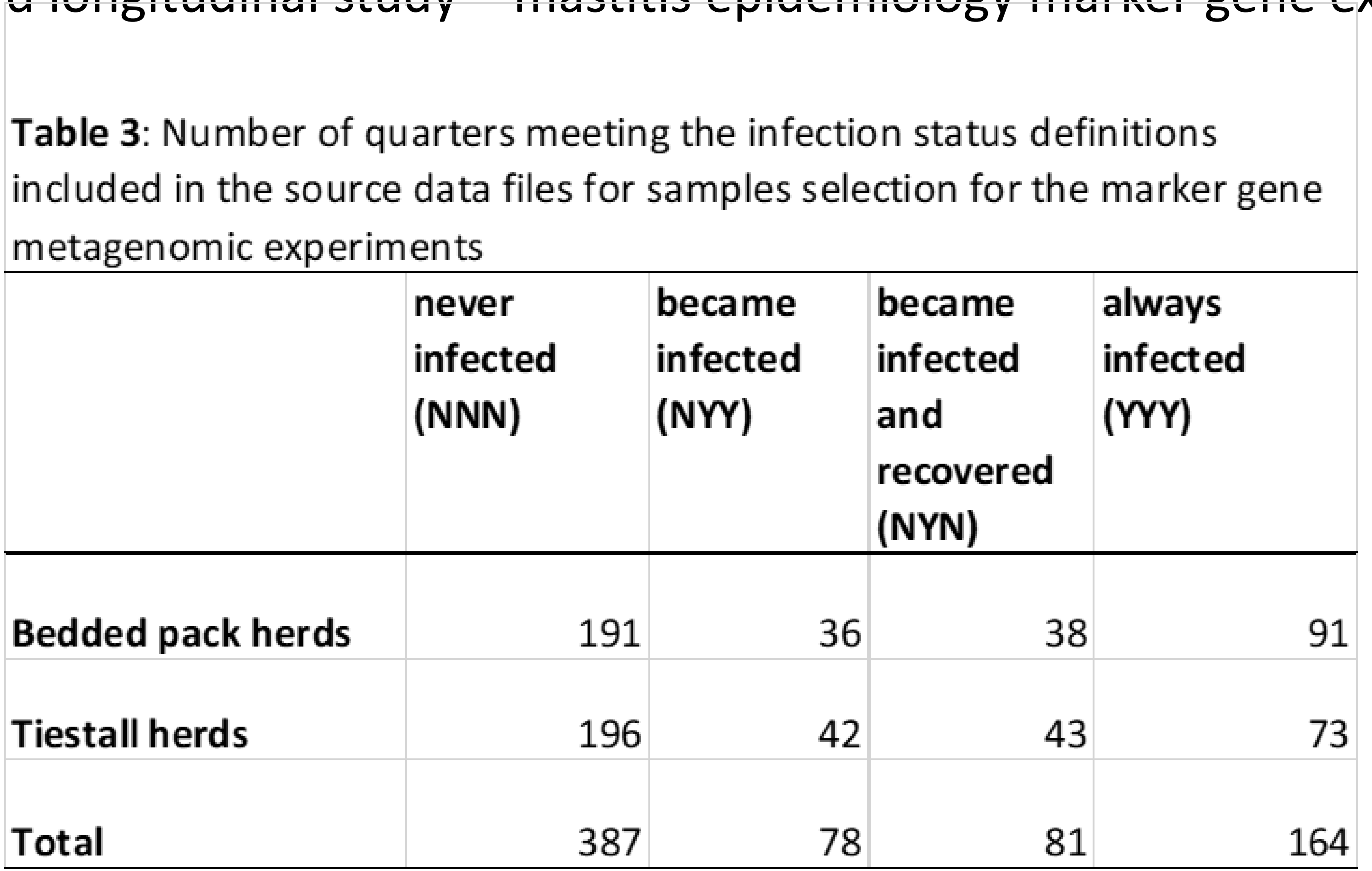


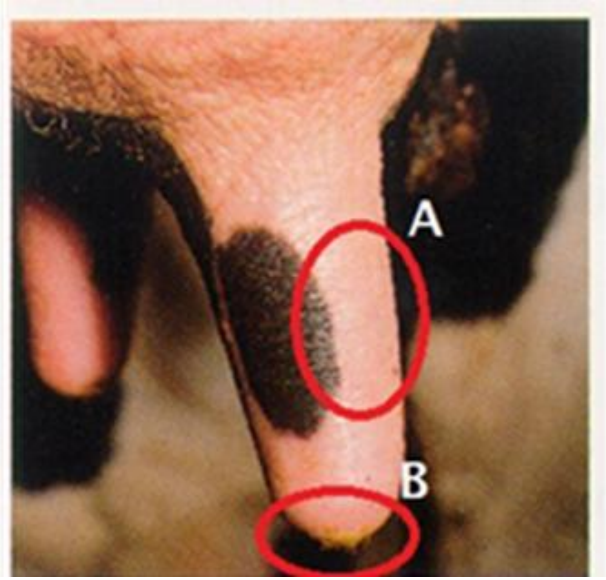
Table 3: Number of quarters meeting the infection status definitions included in the source data files for samples selection for the marker gene metagenomic experiments

	never infected (NNN)	**became infected (NYY)**	**became infected and recovered (NYN)**	**always infected (YYY)**
Bedded pack herds	191	36	38	91
Tiestall herds	196	42	43	73
Total	387	78	81	164

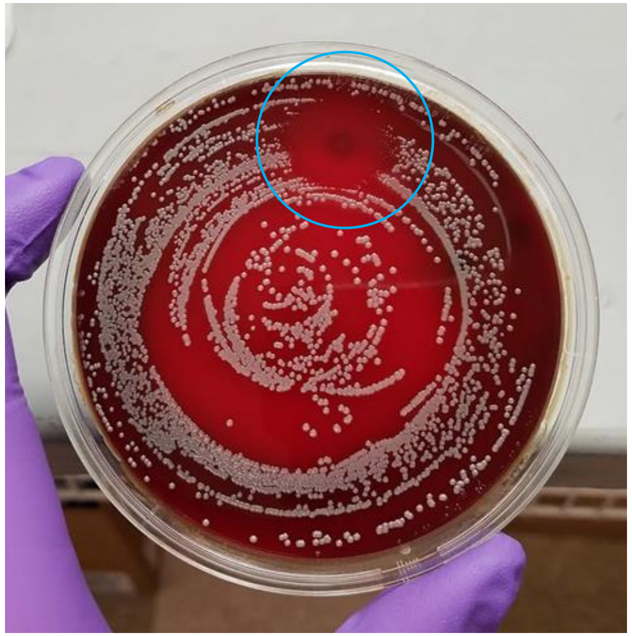
Study Design

- Collected skin swab samples from 8 lactating Holstein cows at the UVM Teaching herd – 50 cow herd, housed in tie-stalls, milked in a parlor, all milkers wear nitrile gloves, chlorhexidine pre- and post-milking teat disinfectant
  - 4 cows with composite milk SCC < 60,000 cells/mL for 5 consecutive months
  - 4 cows with composite milk SCC >280,000 cells/mL for 4 to 5 consecutive months

- Swabbed Three locations: teat barrel (TB), teat end (TE), streak canal (SC)
- 96 total samples
- Samples stored -20°C for up to 4 weeks

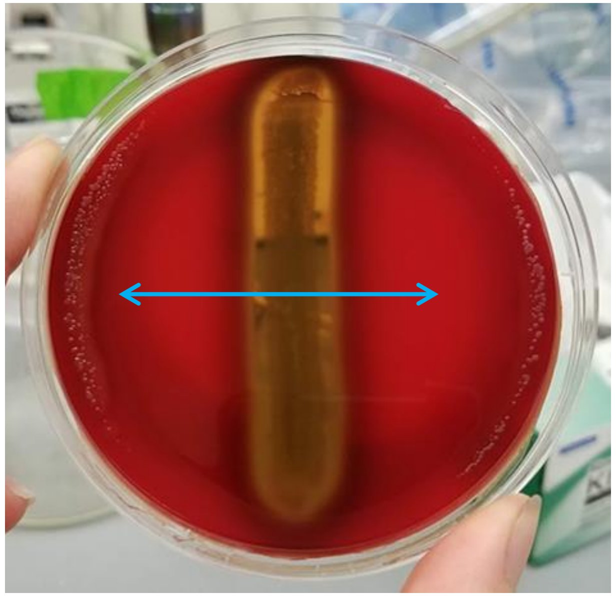


Screening assay



Quantify the number of isolates observed per total cfu/ml plated

Simultaneous antagonism assay



Test plate

Quantify the size of the zone of inhibition for each isolate

Controls

“Bedding strategies that promote udder health and milk quality by fostering a beneficial microbiome on organic dairy farms.”

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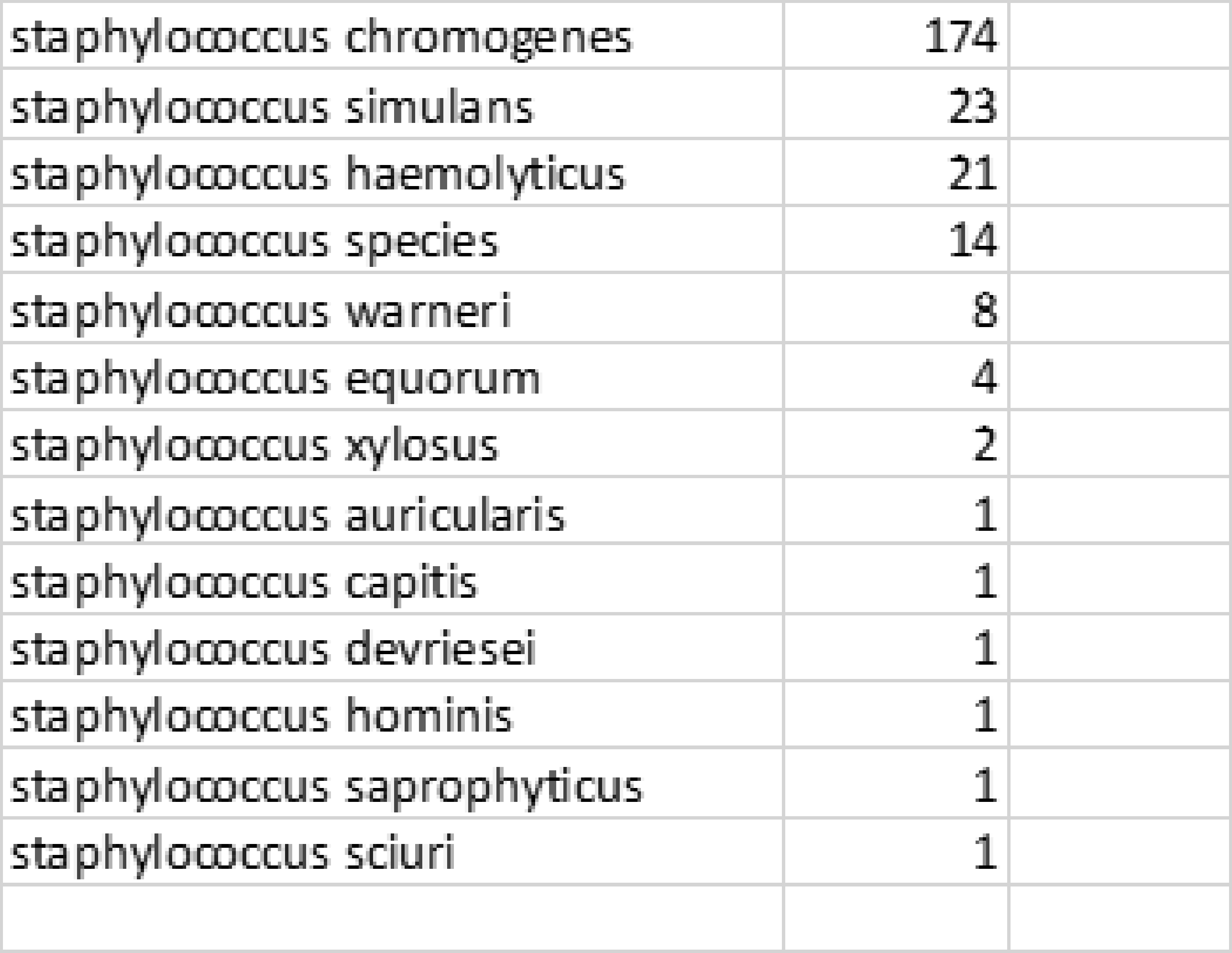
@SoilSuccess

@UVM_BarlowLab

@barlow_lab_uvm



staphylococcus chromogenes	174	
staphylococcus simulans	23	
staphylococcus haemolyticus	21	
staphylococcus species	14	
staphylococcus warneri	8	
staphylococcus equorum	4	
staphylococcus xylosus	2	
staphylococcus auricularis	1	
staphylococcus capitis	1	
staphylococcus devriesei	1	
staphylococcus hominis	1	
staphylococcus saprophyticus	1	
staphylococcus sciuri	1	