USDA
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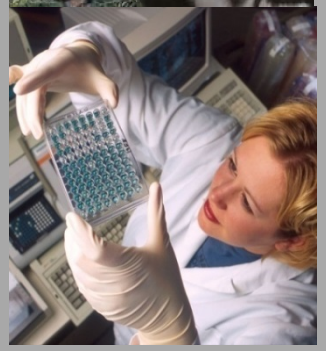
Veterinary Services





Brucellosis in Bison: Past, Present and Future

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U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Veterinary Services
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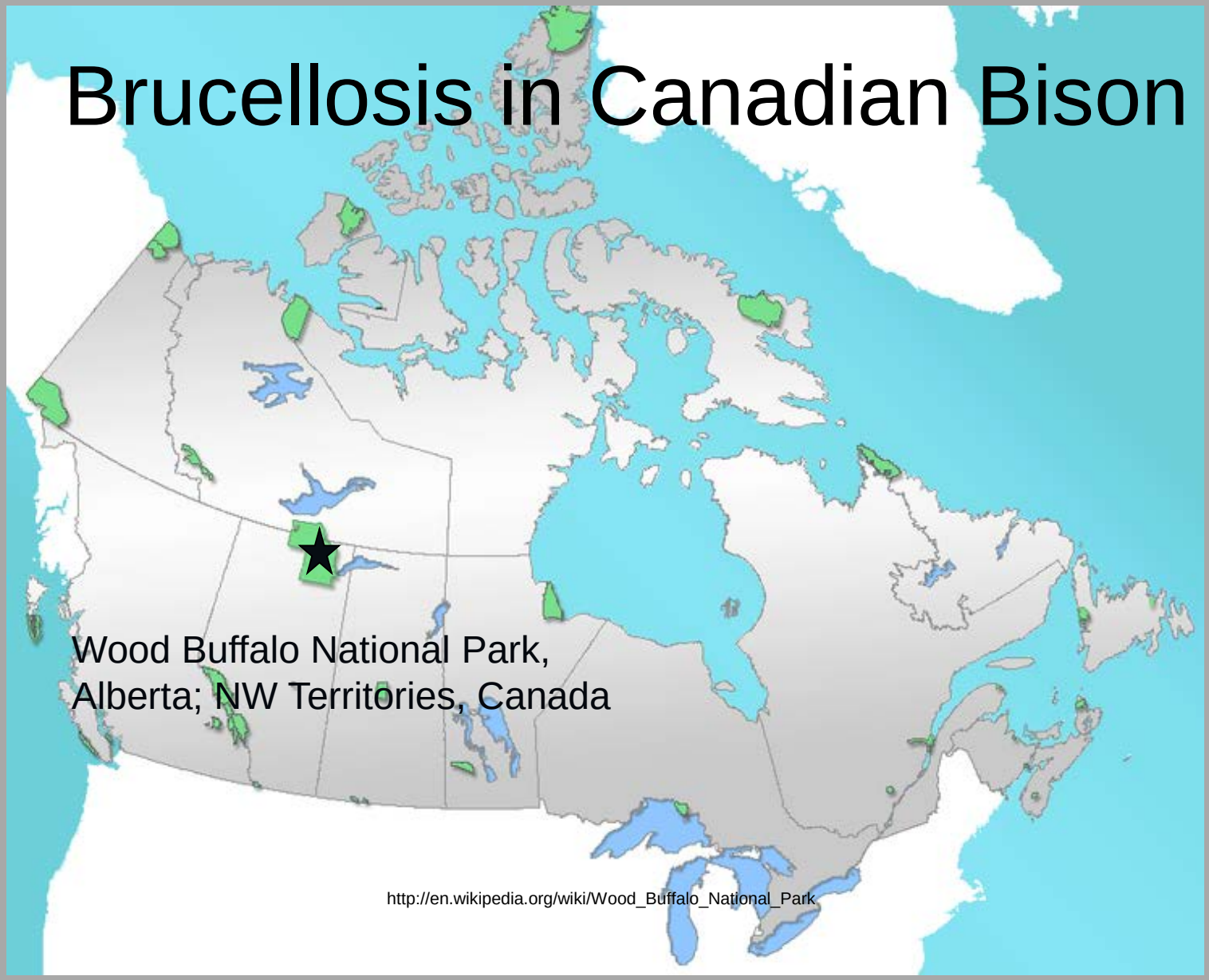
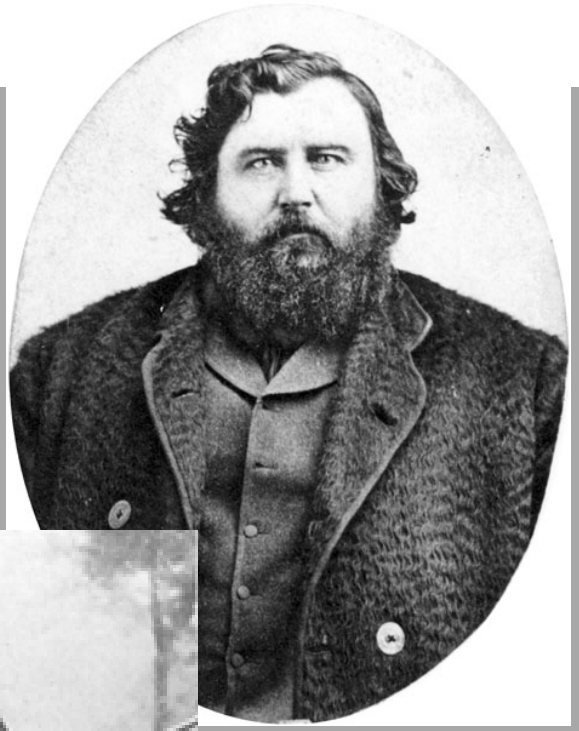
Brucellosis in Canadian Bison

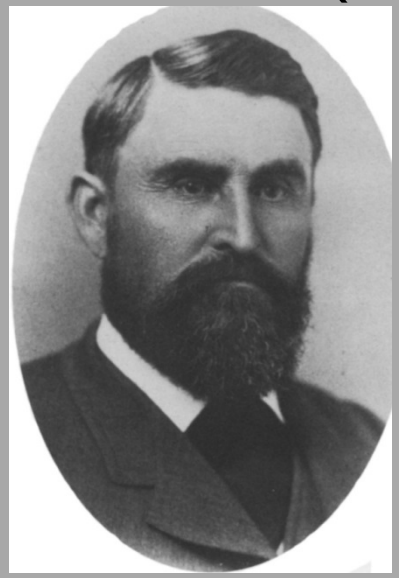


Buffalo Preservation
5 Foundation Herds

- McKay-Alloway herd
- Charles Goodnight herd
- Walking Coyote herd
- Frederick Dupuis herd
- Buffalo (Charles) Jones



James McKay



Chas. & Mary Ann Goodnight

Chas. “Buffalo” Jones

Origins of Yellowstone Herd

"Mountain" Buffalo

Estimated number

1859: 1st report

1880: 600

1891: 200 – 400

1895: 200

1896: 25 – 50

1900: 39

1902: 25

1912: 49

Early Days of Introduced Herd

- 1902 Introduced 18 cows from Pablo-Allard herd and 3 bulls from Charles Goodnight herd
- Jones added three wild calves
- Moved herd from Mammoth to Buffalo Ranch in the Lamar Valley in 1907
- 1910 - herd was grazed on open range during daytime, pastured at night
- 1917 – introduced herd was free-ranging
- Population of introduced herd: 1910 – 121; 1915 – 239; 1920 – 440; 1925 – 764.

Brucellosis

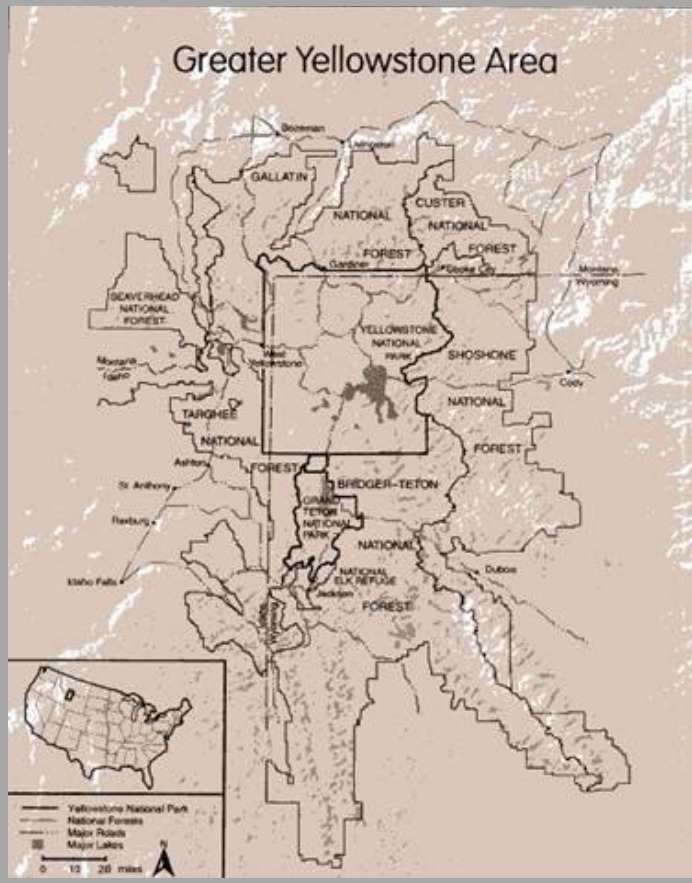
- 1917 – First report of brucellosis in YNP bison. (Mohler, 1917, Annual Reports, USDA 105-106.)
- 1932 – First report of brucellosis in elk in YNP.
- Source of *B. abortus*? Genetic studies of the isolates suggest at least 5 introductions.

Summary of The Past

- Origins of Yellowstone herd
- Since early 1900s, bison and elk in the Greater Yellowstone Area (GYA) – infected with *Brucella abortus*.
- Since early 1900s, winter elk feedgrounds have been maintained in northern Wyoming
- *Brucella abortus* now eradicated from livestock in US except for “spillback” from elk.
- Wild elk and bison in GYA are the last remaining reservoir of *B. abortus* in the US.
- 20 years of research is showing that the disease in bison is similar to that in cattle

Brucellosis in GYA Bison and Elk Current Situation

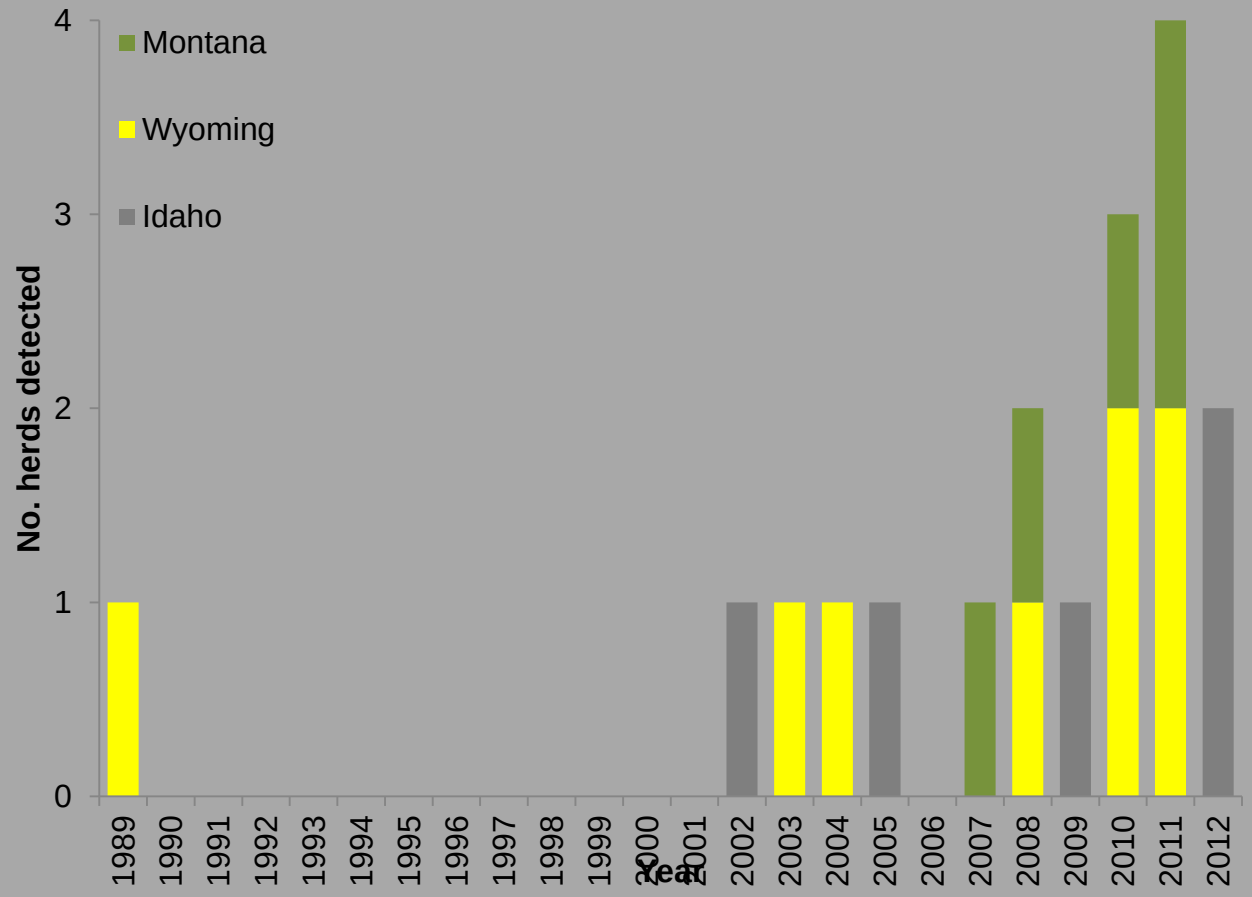
- *Brucella abortus* is endemic in GYA bison & elk
- 3500-5500 bison in GYA
- ~125,000 elk
- 20-25,000 elk fed on 22 state feedgrounds and NER
- Seroprevalence in bison ~50%
- Seroprevalence in elk ~25%
- WY vaccinates elk with Strain 19



Recent Increase of Brucellosis in Elk

- 1988-89: Case of brucellosis transmission from wildlife to cattle
- 1990-2001: No cases of transmission to cattle
- 2002-2013: 17 cases of transmission from elk to cattle and ranched bison

Figure 1. Number of *B. abortus*-positive domestic cattle and ranched bison herds (combined) detected each year between 1989 and 2012



Causes for Increase in Elk?

- Elk population increases
- Land use changes
- Wolves

Pathogenesis and Epidemiology

- Serology correlates well with infection: the higher the titer, the more likely to be culture +. 46% of seropositives are culture positive
- *B. abortus* causes abortions, retained placentas, male reproductive tract lesions in bison
- Retropharygeal, iliac, and superficial inguinal lymph nodes most often culture +

Path and Epi – bison (cont)

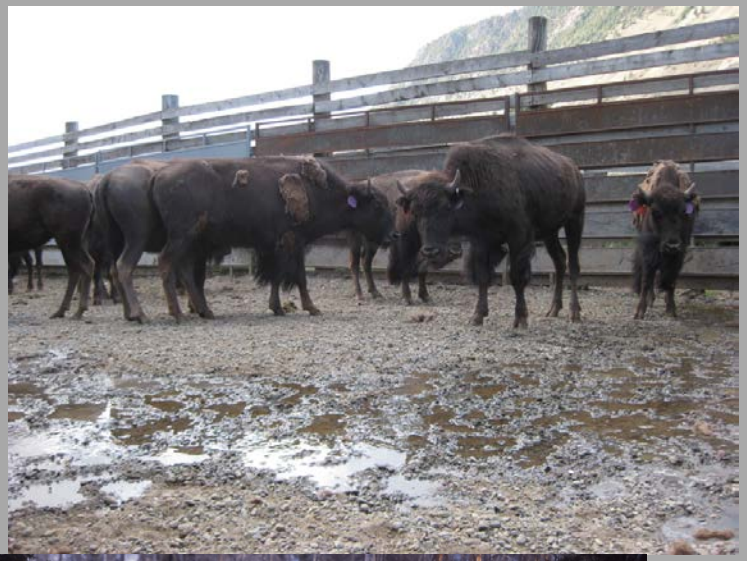
- In YNP, 23% calves and juveniles and 11% adults seroconvert annually
- Antibody is not protective against infection
- In adults, titers are fairly stable
- Risk of shedding highest in first two years post infection
- Most calves are sero-negative by 5 months

Behavioral Differences

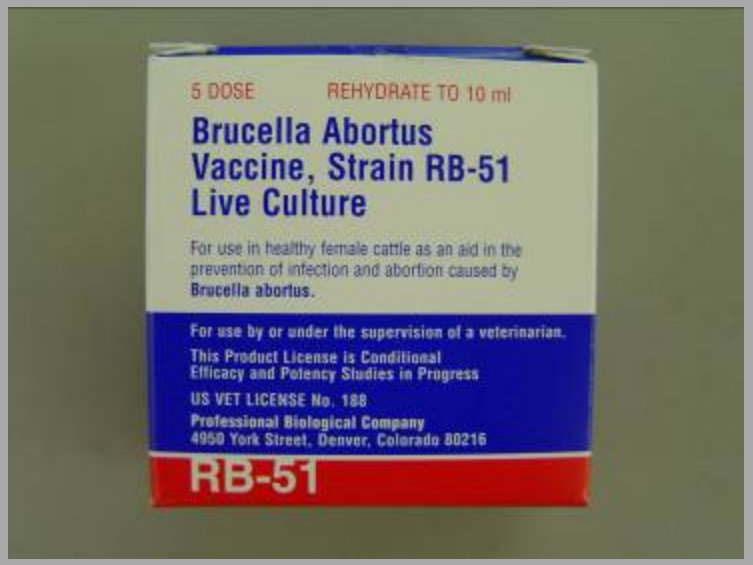
- Two peri-parturient behavioral differences likely cause efficiency of transmission of brucellosis to be different between bison and elk

Brucellosis control techniques in free-ranging bison

- Separation of wildlife from livestock
- Hazing
- Test and slaughter
- Quarantine and ART
- Ban wildlife feeding
- Vaccination
- Contraception



Vaccination



- *B. abortus* RB51
- *B. abortus* strain 19
- RB51 provides some protection from abortion in bison (~60-70%; Boostered RB51 provides >90%); RB51 provides no protection in elk
- Strain 19 provides slight protection (~25%) in elk

Bison Quarantine

- 2005-2012 using quarantine procedures in the USDA Uniform Methods and Rules, a feasibility study resulted in the graduation of 2 groups of approximately 40 bison each and their calves. No evidence of brucellosis yet.

Current GYA Research Directions

- Reproductive work
  - GonaCon™, an immunocontraceptive vaccine
  - Assisted reproductive techniques
- Volatile organic compounds
- Vaccines
  - Spray-dried vaccines for oral delivery
  - Dart for delivery of parenteral vaccines
  - Using natural exposure as a challenge, a potential model for vaccine studies

Reproductive Studies

- Corwin Springs immunocontraceptive study

  First group: 15 GonaCon Vaccs; 15 Controls
  - 1st year: Controls-79% preg; vaccs-20% preg
  - 2nd year: Controls-77% preg; vaccs-13% preg
  - 3rd year: Controls-90% preg; vaccs-36% preg

  Second group: 20 GonaCon Vaccs; 20 Controls
  - 1st year: Controls-90% preg; Vaccs-5% preg

  - Control pasture: 11 *Brucella* abortions; 4/5 sentinels seroconverted and aborted once or twice
  - Vaccinated pastures: 0 abortions; 0 seroconversions

Assisted Reproductive Techniques – collaborating with Dr. Barfield at Colorado State University

First Embryo Transfer – Bronx Zoo

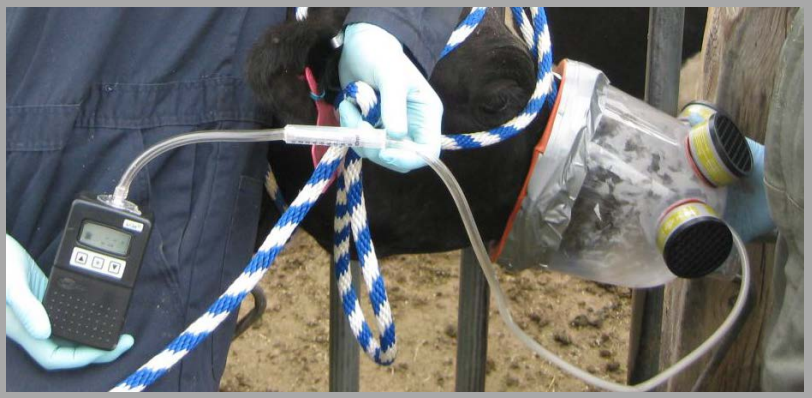
Detection of volatile organic compounds in *Brucella abortus*-positive bison

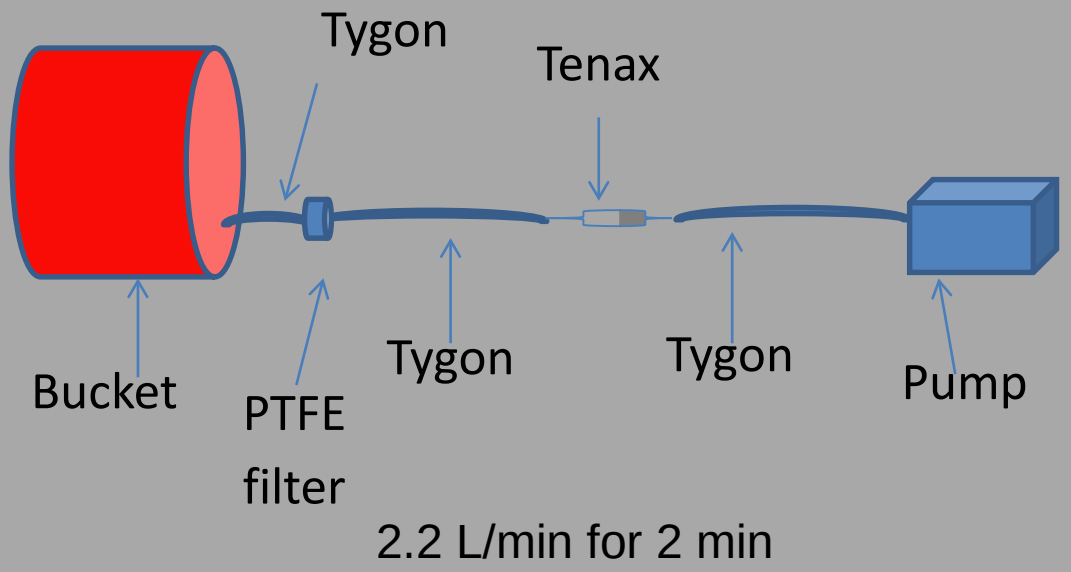
Bayn et al., 2013 *Analytical Chemistry. 85* (22): 11146–11152

- 20 *Brucella abortus* seropositive* bison (9 housed at Colorado facility and 11 housed at Montana facility†)
- 18 seronegative* controls (8 housed at Colorado facility and 10 housed at Montana facility)

*Based on standard *Brucella* serological tests.
†Samples collected at various time points in different locations in MT.

Methods: Breath Collection





Methods: Breath Analysis

Technion-Israel Institute of Technology-Haick Laboratory

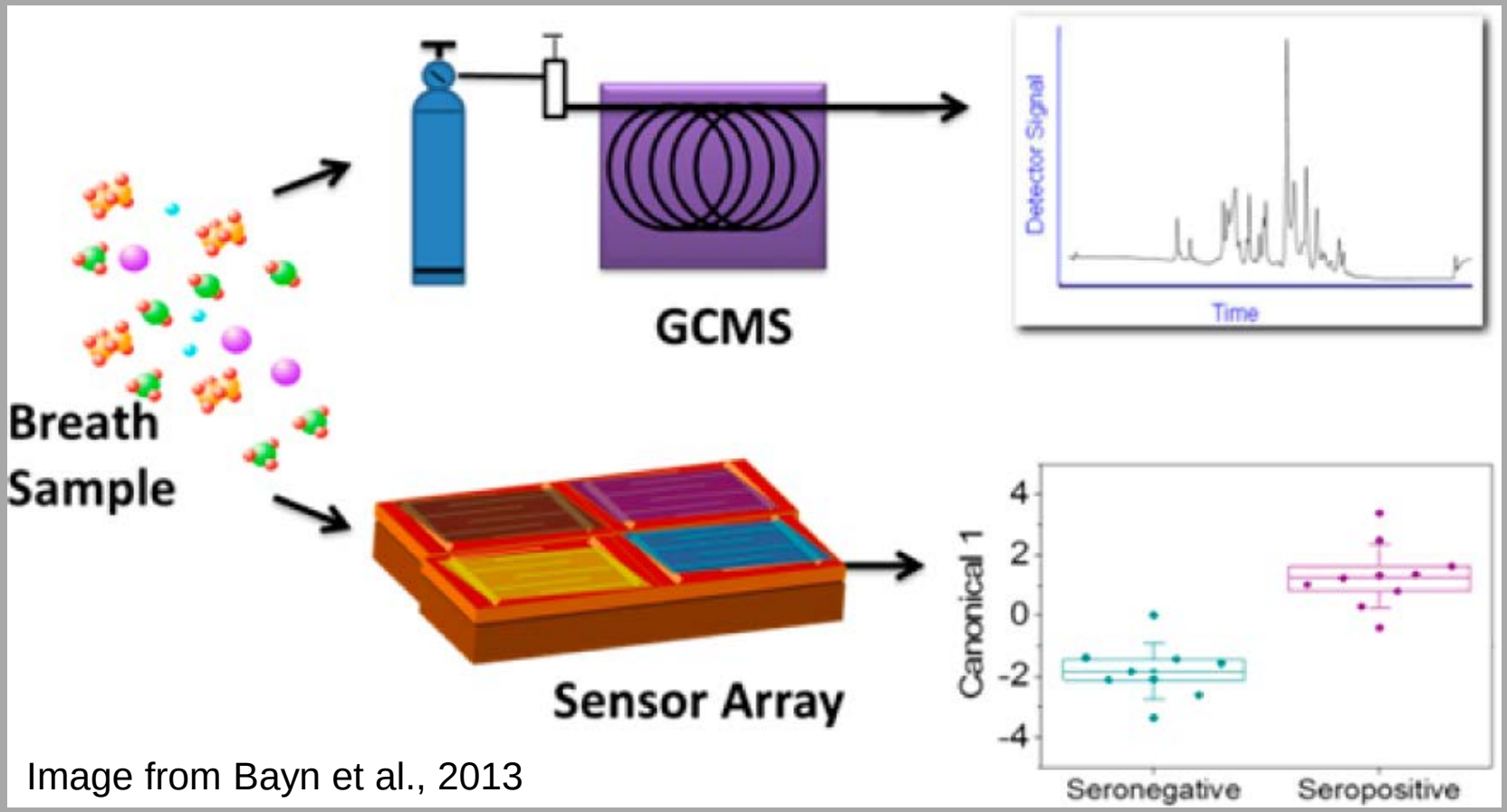


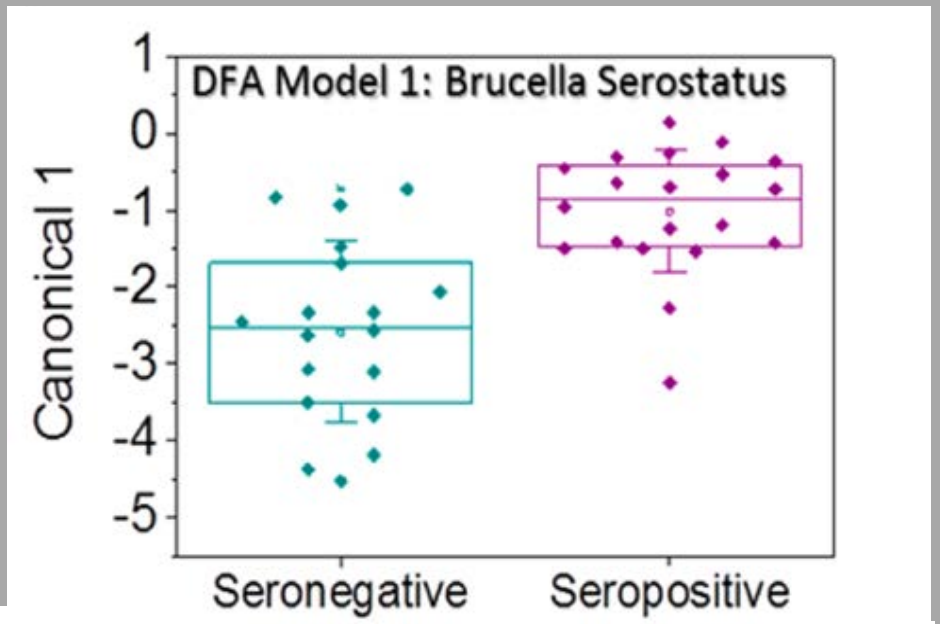
Image from Bayn et al., 2013

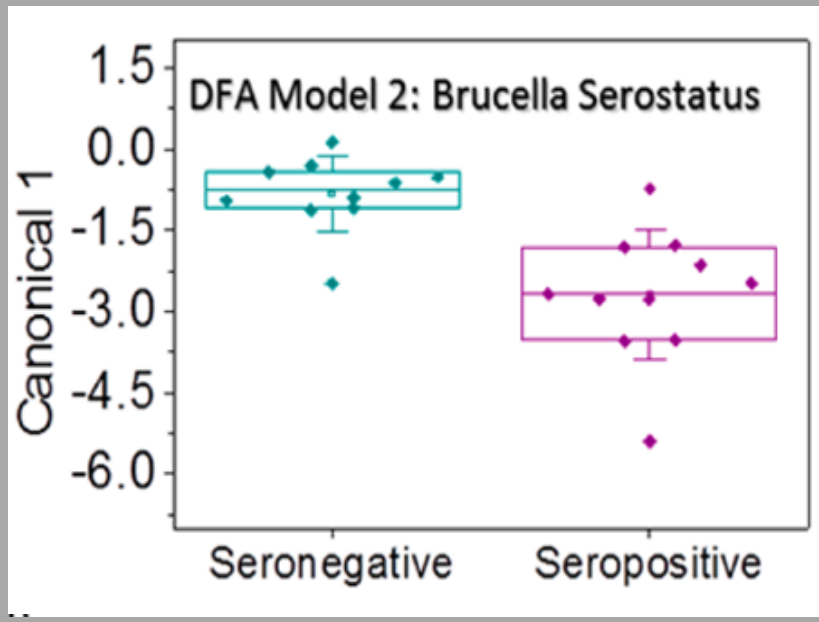
Results

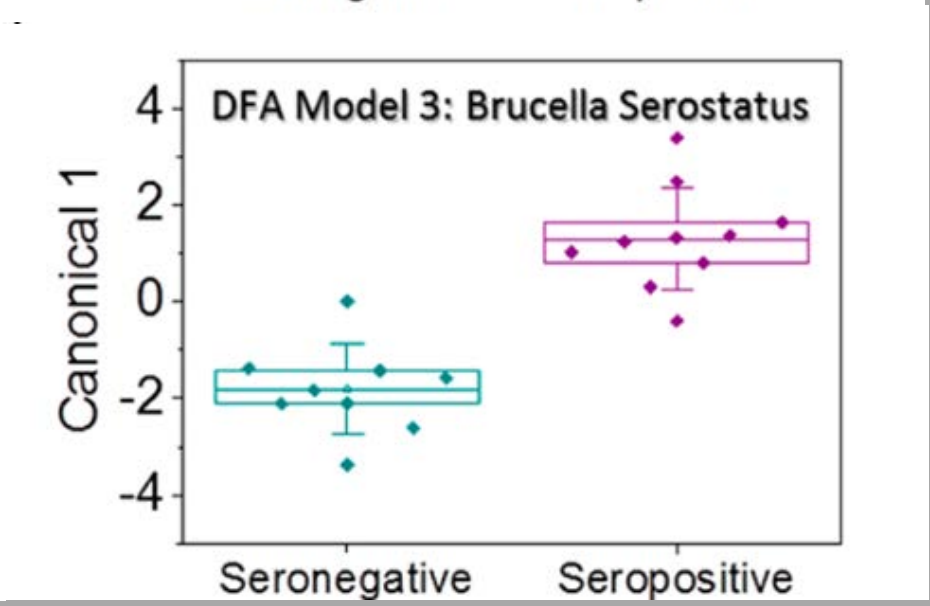
- GC/MS
  - 5 VOCs statistically different (Wilcoxon/Kruskal–Wallis tests)
    - Heptanal
    - 2-ethyl-1-hexanol
    - Acetophenone
    - Benzaldehyde
    - Octanal

Results-NaNose

Serostatus

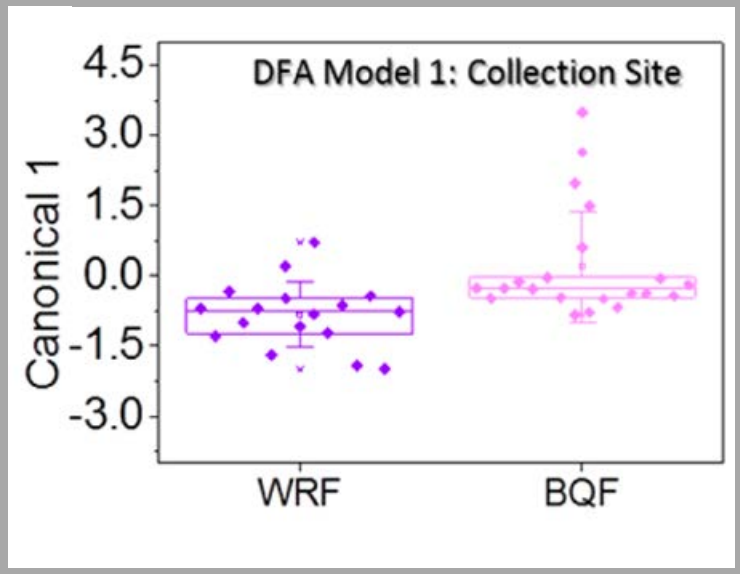


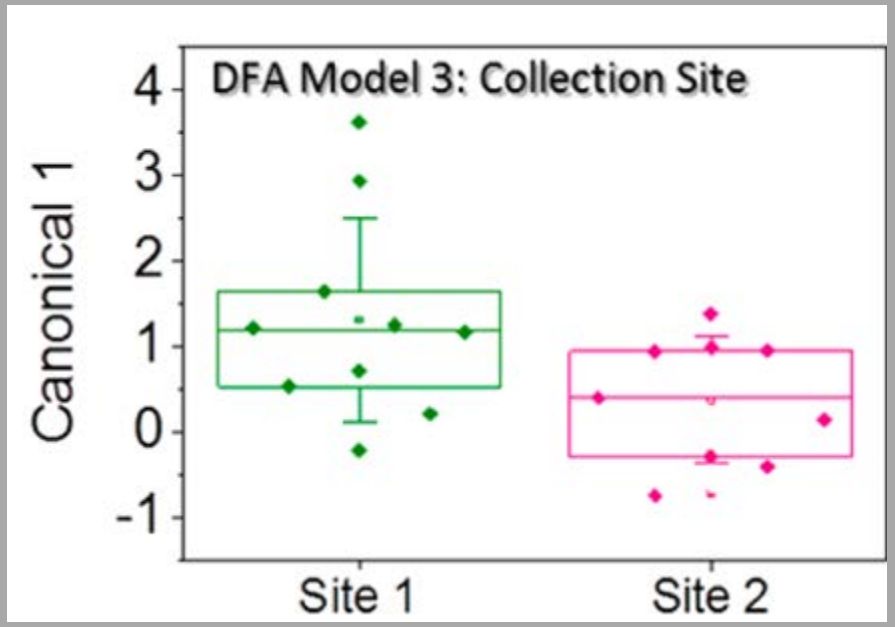




Results-NaNose

Collection Site





Results

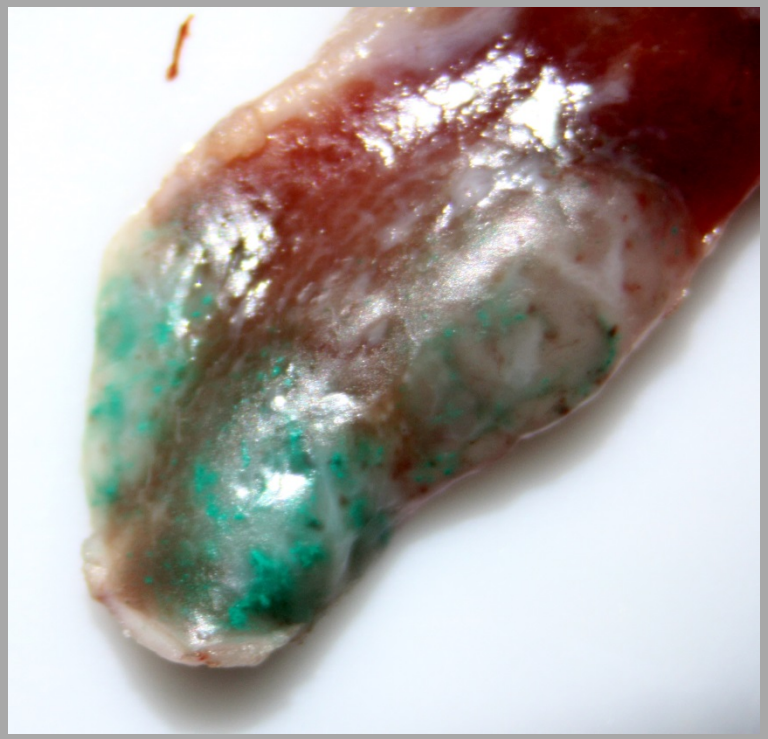
DFA Model	Target Group	Control Group	No. of Animals	TN	FP	FN	TP	Se	Sp
1	**Pos** Bison CO and MT April/May 2012	**Neg** Bison CO and MT April/May 2012	38	18	2	5	13	72 %	90 %
2	**Pos** Bison MT May 2012	**Neg** Bison MT May 2012	21	8	3	1	9	90 %	73 %
3	**Pos** Bison MT Sites 1 & 2 Jan 2014	**Neg** Bison MT Sites 1 & 2 Jan 2014	20	9	1	1	8	89 %	90 %

VOC Summary

- Good discrimination between seropositive and seronegative animals could be achieved.
- Environmental factors did not appear to affect the outcome of the models and were consistent over time.
- Results are supportive of further work in this field

Vaccines: killed, spray-dried, finely powdered vaccine

- Goal: Develop spray-dried, killed, *B. abortus* vaccine for use on feedlines.



DryDart Development

- Developing dart system to deliver lyophilized, powdered, pelleted, or encapsulated vaccines, at range, with accuracy.
- 4X the payload of biobullets; mark injection site.
- Fired from dart gun or shotgun; biodegradable.

Using natural exposure as a challenge, a potential model for vaccine studies

- Goal: Develop vaccine model using natural exposure as challenge.
- 10 elk, 2 undiagnosed elk fetuses
- In 24 hours, 227 contacts of elk with fetuses

Implications for the Industry

- Be vigilant! Early detection and mitigation to stop the infection ASAP!
- Eradication of brucellosis would be best for the industry
- Spin-offs from research could benefit industry, i.e. DryDart and sniffer technologies