DNA TESTING – MFL BISON RANCH LTD.

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Alix, AB

MFL BISON RANCH LTD – OUR DNA TESTING JOURNEY

- Why do DNA testing for purity?
- Who currently conducts DNA testing for bison?
- How is DNA testing currently done?
- What does ‘finding bovine DNA’ mean?
- What did we find at MFL?
- How did we use the data?
- What could you expect if you decide to DNA test your herd?
- Where do we see DNA testing going in the future?

WHY DNA TEST?

- **Canadian Bison Association's 'SIX PRIORITIES':**
  - Financial stability
    - Membership Growth
    - Administration of identification tag sales
  - Support industry growth
    - Producer support
    - Benchmark production and financial information
    - Decision Making Tools
    - Code of Practice
  - Marketing
    - International trade shows
    - Website and Social Media
  - Conservation
    - Work to ensure that Plains Bison remains unclassified under the *Species at Risk Act*
    - Work with Environment Canada and Parks Canada and support strategies to achieve conservation goals while at the same time achieving commercial bison industry goals
  - Policy development
    - Traceability
    - Compensation for destroyed animals
    - Trade
  - Developing and supporting a research strategy
    - Establish a research advisory committee
    - Prioritize research

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traders in the early part of the 19th century that led to the near extinction of the great North American Bison.

Bison Population

The North American Bison population dwindled from approximately 60 million in the 18th century to less than 1,000 by 1890. As Europeans continued to push westward, they hunted the bison primarily for the fur hides these enormous creatures provided. A large number of bison were also simply hunted by the Europeans for sport. The large herds of bison that dominated the western plains and prairies stood in the way of progress. In order for the Europeans to expand, it was necessary to eliminate the obstacles.

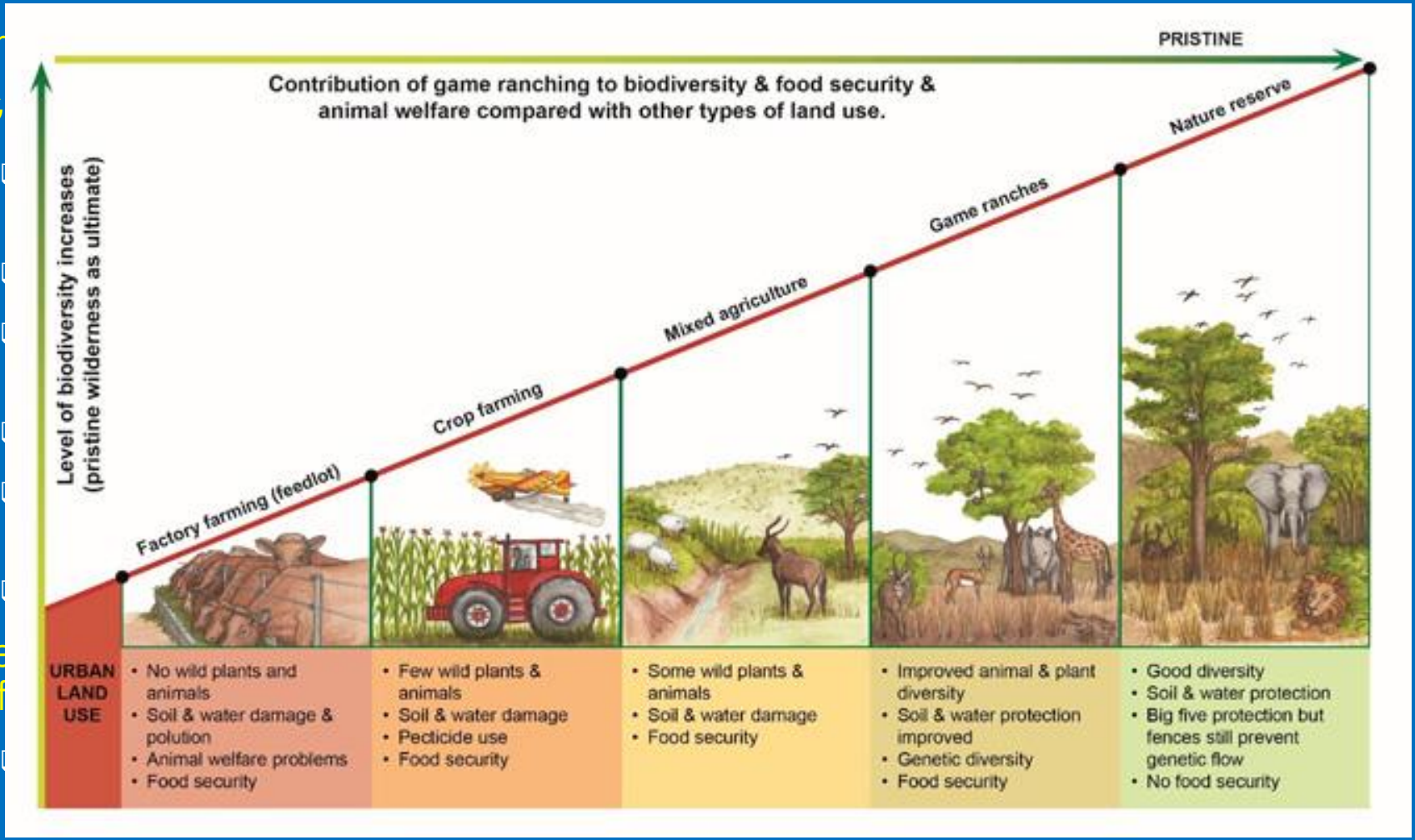
With the formation of the American Bison Society in 1905, the species has managed to survive through captive breeding practices. Today, there are approximately 350,000 bison grazing on North American lands in both public and privately owned herds. However, the majority of these bison have been crossbred with cattle. Only about 10,000 to 15,000 bison that dwell on public lands are considered to be genetically pure North American Bison. Another 50,000 are privately owned.

Yellowstone National Park, Wyoming

The American Bison herd located in Yellowstone National Park descended from the 23 Wood Bison that hid out in the Pelican Valley during the massive hunting of the 19th century. Twenty-one pure Plains Bison were released in the Lamar Valley in 1902. Through natural regulation, the bison population at Yellowstone has steadily grown to approximately 3,500 or more. This is the only area where bison have continually dwelled since

WHY DNA TEST?

- African experience with private sector engagement in conservation
  - Pr
  - G
  - Se of



WHY DNA TEST?

- South African model has spread to Zimbabwe, Botswana, Angola, Zaire, Tanzania, Kenya, etc.
- Parallel research in South Africa and Zimbabwe spawned the regenerative rangeland agriculture practices gaining steam in North America
  - Regenerative Ag is 28% more profitable per acre than conventional Ag – Canada 2017
- DNA testing provides an additional, and highly saleable, background conservation story to the Canadian bison industry

= Good PR!

= More valuable product

= More money in your pocket

= Expanding industry

etc, etc

WHO CURRENTLY CONDUCTS DNA TESTING?

- Texas A&M University
  - Dr James Derr
  - Lab that originated current test – 1999+ ish
  - Primarily a research lab – relatively few bison tested
  - Reports on mtDNA and 14 nDNA gene pairs
  - Slow turnaround times
- University of California Davis
  - Commercial lab – tens of thousands of samples tested
  - Quick turnaround
  - Uses Texas A&M designed test
  - Reports on mtDNA and 26 nDNA gene pairs

- Test is identical, UC Davis simply reports on more gene pairs.

HOW DO WE TEST?

- Tail hair samples
  - Pull 20+ follicles from the tip of the tail
  - Store in dry paper envelope
- Shipping to UC Davis
  - FEDEX
  - Biological samples – requires cross-border paperwork prior to shipping
- Testing can be used for:
  - Bovine mtDNA and nDNA introgression
  - Parentage testing
- Limitations on current test:
  - Microsatellite test – low resolution by modern standards
  - No differentiation between Plains and Woods
  - No genome or origin map
  - No indication of overall genetic diversity

WHAT DOES ‘FINDING BOVINE DNA’ MEAN?

VGL Case #	Animal ID	Sex	Hybridization Status	AME-gender	mtDNA	AGLA17	AGLA293	BL42	BM1314	BM4307	M4513	BM5004	BM7145	BMC3224	BMS2270	BMS4040	CSSM36	CSSM42	FCB193	FCB304	ILSTS005	ILSTS008	INRA107	INRA23	MAF209	MGTG4B	RM185	RM500	SPS113	TG
NCB901	302	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137		132/132	109/125	108/110	176/176	68/68	75/75	159/159	169/173	112/114	125/127	180/180	185/191	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB902	303	F	Cattle allele 197 - BM4307	XX	Bison	215/215	218/218	225/225	137/13	187/197	32/132	109/111	108/108	176/176	68/68	75/75	159/159	169/169	112/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB903	304	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/109	108/110	176/176	68/68	75/75	159/159	169/169	112/114	127/127	180/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB904	305	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	109/123	108/108	176/176	66/68	75/75	159/159	169/169	114/114	123/127	181/181	187/187	160/164	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB905	306	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	187/187	132/132	109/111	108/110	176/176	68/68	75/75	159/159	169/169	114/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB906	307	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	111/123	108/108	176/176	68/68	75/75	159/159	169/173	114/114	125/127	180/180	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB907	308	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	134/134	123/125	108/108	176/176	66/68	75/75	159/159	169/169	114/114	127/127	180/180	185/187	158/160	192/192	124/124	127/127	92/92	123/123	140/140	7
NCB908	309	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/13	185/189	32/134	109/111	108/108	176/176	68/68	75/75	159/159	169/169	114/114	127/127	180/180	187/187	160/164	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB909	310	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	134/134	123/125	108/108	176/176	66/68	75/75	159/159	169/169	112/114	127/127	187/187	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB910	311	F	Cattle allele 197 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/197	132/132	109/123	110/110	176/176	66/66	75/75	159/159	169/169	114/114	125/127	181/181	187/191	158/160	192/192	124/124	127/127	92/92	123/123	136/138	7
NCB911	312	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/134	123/125	108/108	176/176	68/68	75/75	159/159	169/169	114/114	125/127	181/181	185/187	158/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB912	313	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	109/111	108/108	176/176	68/68	75/75	159/159	169/169	114/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB913	314	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	187/189	132/134	109/125	108/108	176/176	68/68	75/75	159/159	169/169	114/114	127/127	0/0	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB914	316	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/134	109/123	108/110	176/176	66/66	75/75	159/159	169/169	114/114	125/127	180/180	187/187	160/162	192/192	124/124	127/127	92/92	123/123	136/138	7
NCB915	317	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	111/125	108/108	176/176	68/68	75/75	159/159	169/169	114/114	127/127	180/181	185/191	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB916	318	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	109/109	108/110	176/176	66/66	75/75	159/159	169/173	114/114	125/127	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB917	319	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/109	108/110	176/176	68/68	75/75	159/159	171/173	112/114	123/125	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB918	320	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	109/109	108/108	176/176	66/68	75/75	159/159	169/169	112/114	123/127	187/187	187/191	160/160	192/192	124/124	127/127	92/92	123/123	140/140	7
NCB919	321	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	111/123	108/110	176/176	66/70	75/75	159/159	169/169	112/112	123/123	180/181	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB920	322	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/109	110/110	176/176	66/68	75/75	159/159	173/173	112/114	127/127	180/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB921	323	F	Cattle allele 197 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/197	132/132	109/109	108/108	176/176	68/68	75/75	159/159	169/173	114/114	123/125	187/187	187/191	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB922	324	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	109/111	110/110	176/176	68/68	75/75	159/159	173/173	112/114	123/125	187/187	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB923	325	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	134/134	109/111	108/110	176/176	66/68	75/75	159/159	169/173	112/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB924	327	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	107/109	108/110	176/176	66/66	75/75	159/159	169/169	114/114	123/125	180/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB925	329	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/134	109/109	108/108	176/176	68/68	75/75	159/159	169/169	114/114	125/127	181/181	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB926	330	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	134/134	109/109	108/110	176/176	68/70	75/75	159/159	169/173	112/114	123/127	187/187	187/191	158/160	192/192	124/124	127/127	92/92	123/123	136/140	7
NCB927	332	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/132	109/123	108/108	176/176	66/68	75/75	159/159	169/169	112/114	125/127	180/180	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB928	333	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/134	111/123	108/108	176/176	68/68	75/75	159/159	169/169	114/114	125/127	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB929	334	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/134	109/123	108/110	176/176	66/66	75/75	159/159	169/169	114/114	123/125	181/181	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB930	335	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	109/123	108/108	176/176	68/68	75/75	159/159	169/169	112/114	125/125	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB931	336	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/111	108/108	176/176	66/68	75/75	159/159	169/169	112/114	123/127	180/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB932	337	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	107/123	108/108	176/176	68/68	75/75	159/159	169/173	114/114	125/127	181/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB933	338	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	109/111	108/108	176/176	68/68	75/75	159/159	169/169	112/114	123/125	181/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB934	339	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	185/189	132/132	109/111	108/110	176/176	66/66	75/75	159/159	169/169	114/114	125/125	180/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB935	340	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	111/123	108/108	176/176	66/66	75/75	159/159	169/169	112/114	123/125	181/187	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB936	341	F	Cattle allele 189 - BM4307	XX	Bison	215/215	218/218	225/225	137/137	187/189	132/132	109/109	108/110	176/176	66/66	75/75	159/159	169/169	114/114	125/127	0/0	187/191	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB937	342	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	187/187	132/132	109/109	108/108	176/176	66/68	75/75	159/159	169/169	114/114	125/127	187/187	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB938	343	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/123	108/110	176/176	68/68	75/75	159/159	169/169	114/114	125/127	181/187	187/187	160/162	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB939	417	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	107/109	108/108	176/176	66/66	75/75	159/159	169/173	114/114	127/127	181/181	185/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB940	733	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	109/109	108/108	176/176	66/66	75/75	159/159	169/171	112/114	123/127	180/180	185/187	160/160	192/192	124/124	125/127	92/92	123/123	138/140	7
NCB941	819	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/134	109/111	108/108	176/176	66/68	75/75	159/159	169/173	112/112	125/127	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB942	825	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	111/123	108/108	176/176	66/68	75/75	159/159	169/169	114/114	127/127	181/187	187/187	160/162	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB943	827	F	Cattle allele 91 - BMS4040	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	123/123	108/110	176/176	66/68	75/91	159/159	169/173	112/114	123/127	180/180	185/185	160/164	192/192	124/124	127/127	92/92	123/123	136/138	7
NCB944	838	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/134	109/123	108/108	176/176	66/68	75/75	159/159	169/169	112/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB945	937	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	109/123	108/110	176/176	68/68	75/75	159/159	169/173	112/114	127/127	180/180	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB946	37	F	No cattle allele detected	XX	Bison	215/215	218/218	225/225	137/137	187/187	132/132	109/109	108/110	176/176	68/70	75/75	159/159	169/169	112/114	125/127	180/181	187/191	160/160	192/192	124/124	127/127	92/92	123/123	138/140	7
NCB947	345	M	No cattle allele detected	YX	Bison	215/215	218/218	225/225	137/137	185/187	132/132	111/123	108/110	176/176	66/68	75/75	159/159	169/169	112/114	125/127	187/187	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB948	346	M	No cattle allele detected	YX	Bison	215/215	218/218	225/225	137/137	185/185	132/134	109/109	108/110	176/176	68/68	75/75	159/159	169/169	114/114	123/127	181/181	187/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB949	347	M	Cattle allele 189 - BM4307	YX	Bison	215/215	218/218	225/225	137/137	185/189	132/132	111/123	108/108	176/176	68/68	75/75	159/159	169/173	114/114	125/125	181/181	187/187	160/160	192/192	124/124	127/127	92/92	123/123	138/138	7
NCB950	348	M	No cattle allele detected	YX	Bison	215/215	218/218	225/225	137/137	185/185	132/132	109/111	108/108	176/176	68/68	75/75	159/159	169/169	112/114	127/127	181/181	185/187	158/160	192/192	124/124	127/127	92/92	123/123	138/138	7

WHAT DOES 'FINDING BOVINE DNA' MEAN?

 Molecular Ecology, 14, 2343–2362

Appendix *Continued*

PIT17B7	AI	CSP	CW	EIP	EIW	FN	GC	HM	MBS	MGR	NBR	TSBH	WBNP	YNP	AN	HE	HO	SH	TLH
128															35.00	12.50	26.92	50.00	16.67
132																3.13			
133															5.00	9.38	7.69		5.56
135																9.38			
137															5.00		7.69	4.17	
139		2.56				22.22									50.00	62.50	57.69	41.67	77.78
141															5.00			4.17	
143	9.38	3.85				9.26	4.69	2.38		3.75	3.95	11.43		1.79		3.13			
145	81.25	53.85	72.73	50.00	32.00	33.33	25.00	61.90	22.86	28.75	27.63	41.43	25.00	37.50					
147		8.97		4.00															
150				4.00	26.00				30.00		5.26		27.08	17.86					
155	3.13	24.36	4.55	22.00	4.00	5.56	14.06	21.43	1.43	3.75	15.79		8.33	17.86					
157	1.56		22.73		18.00	1.85	3.13	7.14	15.71	12.50	39.47		16.67	25.00					
159	4.69	6.41		20.00	20.00	27.78	53.13	7.14	30.00	51.25	6.58	17.14	22.92						
161											1.32	30.00							

BMS4017	AI	CSP	CW	EIP	EIW	FN	GC	HM	MBS	MGR	NBR	TSBH	WBNP	YNP	AN	HE	HO	SH	TLH
145														14.29					
148		2.70													45.00	13.33	57.69	62.50	65.38
153		6.76	13.64	4.00				9.52	1.43	1.25			2.08						
154						20.37									50.00	20.00	11.54	25.00	23.08
155	1.56	51.35	50.00	32.00	8.00	50.00	89.06	16.67	61.43	56.25	55.26	62.86	47.92	42.86					
156																50.00	3.85	12.50	11.54
157					26.00				12.86		3.95	34.29	8.33						
158															5.00	16.67	26.92		
159	93.75	12.16	27.27		50.00	12.96		7.14	12.86	26.25	7.89		18.75	23.21					
161	1.56	12.16				1.85		4.76		10.00				1.79					
163	3.13	14.86	9.09	16.00	16.00	14.81	10.94	40.48	11.43	5.00	9.21	2.86	14.58	16.07					
165				48.00				21.43		1.25	23.68		8.33	1.79					

BM4307	AI	CSP	CW	EIP	EIW	FN	GC	HM	MBS	MGR	NBR	TSBH	WBNP	YNP	AN	HE	HO	SH	TLH
183															11.11				
185	98.44	75.64	54.55	95.83	60.00	77.78	84.38	92.86	71.43	60.00	85.53	47.14	70.83	100.00	22.22	12.50	16.67	9.09	
187	1.56	21.79	45.45	4.17	40.00	1.85	15.63	7.14	28.57	40.00	14.47	52.86	29.17			3.13			
189		2.56													11.11	37.50	54.17	54.55	19.23
191																6.25	4.17	9.09	15.38
197						20.37									55.56	40.63	25.00	22.73	38.46
199																		4.55	26.92

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BISON GENETIC MARKER REPORT

RICHARD, KARINA, STEWART AND MARIEM STAUDI O/A MFL BISON RANCH LTD BOX 25 ALIX, ALBERTA T0C 0B0 CANADA	*Case:* **NCB2269** *Date Received:* 26-Mar-2018 *Print Date:* 12-Apr-2018 *Report ID:* 3213-3872-5953-3117 Verify report at www.vgl.ucdavis.edu/myvgl/verify.html

Name: **0018** *Reg:*

DOB: **01/01/2015** *Sex:* **Male** *Breed:* **Unknown**

Sire: *Reg:*

Dam: *Reg:*

ANALYSIS

Permanent Record.

GENETIC MARKERS

LOCUS	TYPE	LOCUS	TYPE	LOCUS	TYPE
BM1225	241	*BM1706*	232/254	*BM17132*	85/91
BM720	225/229	*BMC4214*	185	*BMS1001*	113/115
BMS1117	93	*BMS1862*	142/168	*BMS2639*	170
BMS410	83/97	*BMS527*	175	*INRA194*	154/156
RM372	130/132	*SPS115*	250/254	*TGLA44*	149/153

WHAT DID WE FIND?

- End 2013 – tested calf crop
  - Discovered that bovine DNA alleles tend to only appear on one side of a gene pair
  - A cow with one bovine gene allele in a pair can throw a 'pure' calf
- 2014 – tested all breeding cows and bulls
  - 130 cows & heifers tested
    - 23 found with bovine nDNA (17.7%)
    - 1 cow found with bovine mtDNA
  - 9 bulls tested
    - 3 bulls found with bovine nDNA (33%)
- 2015
  - Only 7.6% of stock showing bovine DNA were carried forward to 2015 breeding season

WHAT DID WE FIND?

- 2015-2017
  - Continued testing individual calves from cows with bovine DNA
  - Continued testing one herd that had a bull with bovine DNA
  - Testing of herd replacements purchased from other ranches/parks revealed similar percentage of bovine DNA

HOW DID WE USE THE DATA?

- 2015-2017
  - Culled out breeding stock showing bovine DNA
    - Only 7.6% of breeding herd had bovine DNA by spring 2015
  - Tested calf crop to confirm clear and to get more detail from sires/dams showing bovine DNA
  - Initial cull in 2014/2015 meant our normal herd replacement program got stretched
    - Kept several cows we would normally have culled
    - Replacement heifer numbers limited by residual bovine DNA from culled cows
    - 2015-2017 – worked last few animals into normal cull program
  - Last cows with bovine nDNA shipped in 2017, last bull shipped 2016
  - 2018 calf crop is the first from completely 'clean' breeding stock herd
- All breeding stock since Dec 2015 have been sold free from bovine DNA

WHAT COULD YOU EXPECT IF YOU STARTED TESTING?

- Plains - Expect approximately 25% nDNA introgression – Dr Derr
  - We had 17.7% of our females with bovine DNA markers
  - We had 33% of our bulls with bovine DNA markers
- Plains - Expect up to 10% mtDNA introgression – Dr Derr
  - Aggressive selection on performance reduces mtDNA
  - We found one cow with bovine mtDNA
  - KenMar in North Dakota found only 2 cows & calves with bovine mtDNA (625+ animals tested)
- Woods – Expect nothing (unless they're not 100% Wood)
  - No known cattle & wood bison crossing experiments
- Cross-bred – expect lower figures than with Plains

WHERE DO WE GO FROM HERE?

- Last two years:
  - Significant public interest in DNA testing for purity
  - Growing number of enquiries from ranchers interested in developing pure herds
    - Strongest interest from ranchers new to bison
    - Market for breeding stock
    - Market for commercial lab services in Canada
  - Growing market for 'conservation agriculture' products

- New DNA test
  - Much higher resolution test – Single Nucleotide Polymorphism (SNP) vs legacy microsatellite test
    - Tens of thousands of genes vs tens of genes
    - Exploit bison genome research completed in last 15 years

WHERE DO WE GO FROM HERE?

- Valuable data from a newer test:
  - Bovine DNA introgression – greater accuracy
  - Differentiate Plains & Woods
    - Maintain pure strains of feed-stock for cross-breeding
    - Percentage of cross for cross-breeding programs
    - Predict hetrosis (hybrid vigour) performance benefits
    - Select for best performance improvements
  - Differentiate genetic sub-populations within Plains/Woods
    - Identify bison Haplotypes/Haplogroups
    - Target rare genetics for preservation breeding
    - Selection of herd replacements to improve overall herd diversity
  - 'Index of Genetic Diversity'
    - General predictor of resilience to disease
    - General predictor of performance and hardiness

WHERE DO WE GO FROM HERE?

- Conservation Agriculture
  - Subset of Regenerative Agriculture
    - More profitable than industrialised Ag
  - African experience demonstrates clear advantages of private sector over public sector in conservation management
    - Simulation of genetic transfer of nomadic herds
    - Holistic management of keystone species on rangeland has knock on effects
      - Increase in biodiversity
      - Increase in biomass carrying capacity per acre
      - Regeneration of natural habitat for niche plant and wildlife species
  - Growing market for Regenerative Ag products
    - Up to twice the nutrient density of conventional Ag products
    - Improved health benefits for livestock, wildlife and humans
  - Building a future-proof and resilient industry

WHERE DO WE GO FROM HERE?

- Public Engagement
  - Social Media
  - Wikipedia
  - Face-to-Face

- **75%+ of all bison are 'pure'**

- For the foreseeable future, privately owned herds will remain (on average):
  - More genetically diverse than park herds
  - Healthier than park herds
  - Essential to the long term preservation of the species


QUESTIONS?