

# **Bison Conservation Genetics**

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# General types of genetic variation

**Adaptive**

Variants that have a **positive** influence on fitness

**Neutral**

Variants where the effect of selection is less than that of genetic drift ( $s < 1/(2N_e)$ )

**Detrimental**

Variants that have a **negative** influence on fitness

# Genetics Issues in Bison

**(1) Cattle ancestry in bison**

**(2) Inbreeding depression**

**(3) Genetic variation within and between herds**

**Hedrick 2009. *J. Heredity* 100:411-420**

**Hedrick 2010. *Molec. Ecol.* 19:3328-3335**

# Introgression or Hybridization and Types of Genetic Variation

Common or domestic  
species (cattle)

Detrimental

Neutral

Adaptive

Wild or  
endangered  
species  
(bison)

Detrimental

Neutral

Adaptive

			<b>Cattle mtDNA in bison</b>
		<b>Markers for cattle ancestry</b>	
			<b>MHC disease resistance</b>

## Cattle Ancestry in Bison Herds

	mtDNA	Y	Autosomal
Santa Catalina I., CA	0.43	---	0.0061
Williams Ranch, TX	1.0	0.0	0.0
National Bison Range, MT	0.018	0.0	0.0027
Badlands NP, SD	0.0	---	0.0119
Yellowstone NP, WY	0.0	---	0.0
Wind Cave NP, SD	0.0	---	0.0

# mtDNA and Autosomal Cattle Ancestry in Bison

<b>Herd</b>	<b>mtDNA</b>	<b>Autosomal</b>	<b>mtDNA / A</b>
<b>Williams Ranch</b>	<b>1.000</b>	<b>0.000</b>	<b>-</b>
<b>Houserock Ranch</b>	<b>0.975</b>	<b>0.019</b>	<b>51.0</b>
<b>Santa Catalina I.</b>	<b>0.449</b>	<b>0.006</b>	<b>74.8</b>
<b>Custer State Park</b>	<b>0.206</b>	<b>0.015</b>	<b>13.7</b>
<b>Maxwell Refuge</b>	<b>0.180</b>	<b>0.011</b>	<b>16.4</b>
<b>Texas State Bison</b>	<b>0.167</b>	<b>0.000</b>	<b>-</b>
<b>16 other herds</b>	<b>0.0053</b>	<b>0.0050</b>	<b>1.1</b>
<b>All 22 herds</b>	<b>0.1392</b>	<b>0.0060</b>	<b>23.2</b>

# Possible Explanations for Higher mtDNA than Autosomal Cattle Ancestry in Bison

- (1) Differential success in interspecies crosses and backcrosses**
- (2) Selection against autosomal regions**
- (3) Selection against both mtDNA and autosomal regions**
- (4) Historical and chance effects**

# Crosses between Bison and Cattle (*Bos taurus*)

(diverged about 2 million ybp)

	Cattle ancestry			
	mtDNA	Y	Autosomal	mt / A
(1) Male bison X Female cattle (only F <sub>1</sub> female progeny)	1.0	---	0.5	2.0
(2) Male bison X F <sub>1</sub> females (mostly female progeny)	1.0	0.0	0.25	4.0
(t) Male bison X BC females	1.0	0.0	(0.5) <sup>t</sup>	2 <sup>t</sup>





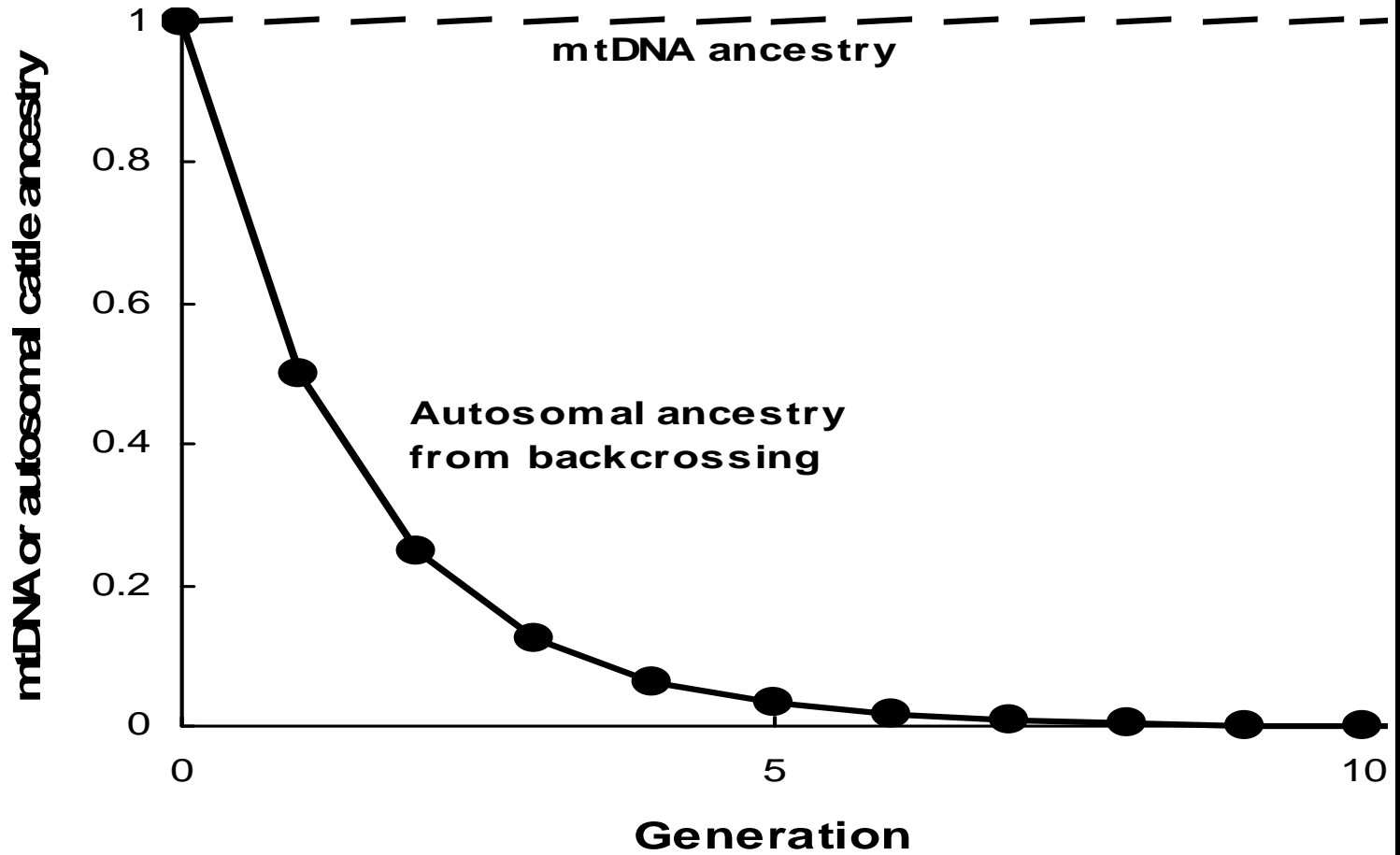
**HEIFER WITH HALF BUFFALO BLOOD.**



**THREE-QUARTERS-BUFFALO BULLS.**



A "HEREFORD" WHO IS FIVE-SIXTEENTHS BUFFALO.



## Cattle Ancestry from Backcrossing

# Effect of Cattle mtDNA on Bison Weight (kg)

(D. Hedgecock, unpublished)

	mtDNA		
	Bison	Cattle	Weight decline
Males	375.1	335.4	10.6%
Females	300.4	278.2	7.4%

## **What does the high frequency of certain cattle alleles in bison indicate?**

- (1) Positive selection for the cattle alleles**
- (2) Common ancestry of herds**
- (3) Chance effects**

# Cattle Ancestry in Bison

## **(1) Populations without cattle ancestry**

- keep separate
- use as source for other populations
- manage for retention of bison variation

## **(2) Populations with cattle ancestry**

- eliminate mtDNA cattle ancestry (and autosomal ancestry as possible)
- manage for retention of bison variation