Title: Dancing Between Two Worlds- an Attempt to combine Pre-19th Century Native American Knowledge with 21st Century Science.

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Note by author: The scientific field studies and statistics used are accurate. However, some of the uses of these plants may not be accurate as they are based on Native American Legends.

Introduction: Grasslands are effected by three major factors-grazing, fire, and precipitation. (Johnson, E.) This research focuses on the effects of grazing by the American Bison (*Bison bison*).

Prior the 1800s, between 30 to 60 million American bison roamed the wilds of North America. Bison was the keystone species of the North American continent. Except for man, no other animal can kill a fully grown male, called a bull. Even a fully grown female, called a cow, is hard to kill.

In winter many grazing mammals, such as deer may starve to death because the snow covers the vegetation, and they cannot reach it. Not so with Bison. With their strong, huge shoulders and heads, they merely plow through the snow pushing it out of their way to graze.

Many animals, can also freeze to death or get frostbite in sub-zero temperatures as their coats are often too thin for much protection. Not so with bison. In fact, one can often see snow on a bison's back. This is because its coat is so thick that the heat emerging from the warm body beneath the coat cannot penetrate the thick fur.

(Belovsky) This fur is shed in the spring and summer and grows again in late summer or early fall, giving the bison a new coat every year. (Schult)

Native Americans realized the value of the bison. Almost every part of the bison is usable. The meat can be eaten freshly cooked or tuned into pemmican or jerky. The hide is used for making coats that will keep a person warm in frost-bite weather. The bladder and stomach can be used to make water containers and the sinews can be used as thread. Bones can be made into all sorts of items such as tools or decorations. (Johnson, A.)

Unfortunately, the modern perception of Native Americans, pre-1800 is often that they lived in perfect harmony with nature and wasted no part of the bison. However, just because every part of the bison is usable, not every part of every bison was used. (Johnson, A.)

For example, buffalo jumps were clever and efficient means to kill bison, but could hardly be called ecological. In this type of hunting, bison would be herded into a narrow corridor. They would be chased, other bison would follow and with no-where else to go, they would run off a cliff. Some bison were killed by the impact of falling. Others bison were crippled and then shot with bows and arrows. The problem with bison jumps was that the tribe may have been able to process a small number of bison at a time. However, once a group of bison gets running, it cannot be halted when the number of bison killed are enough. Bison follow other bison in these runs, and perhaps the entire herd may be killed. The processing must be done quickly because the smell of blood draws in wolves and other animals. Sometimes only the tongue and liver (the most delicious and nutritious) parts were taken. The bison then become carrion for other animals. After a bison jump was used it may be several months until the area was clean enough to use again. Certain tribes held Sun Dances in which 200 bison tongues were needed. Often, this was the only part of the buffalo used and the rest was wasted. (Johnston, A.)

“One could make a cogent argument that the widespread advent of buffalo jumps marked the beginning of the end for buffalo. It seems as though the massive, wholesale slaughter of complete buffalo herds was like an addictive drug” (Rinella p167)

This was a technique of hunting, however, and even though it was wasteful, the whole idea was to use the bison for food, or ceremonies. Bison were not killed to deliberately destroy them. In the 1800’s however, this magnificent animal- the Keystone Species of North America almost became extinct partially due to over-hunting, and bovine disease from domestic cattle. However, one of the more heinous ways the bison almost became extinct was the purposeful slaughter of the bison, with the idea that if the Native Americans' food supply disappeared the Native Americans would follow in their demise.

When we lost (most of) the bison, we lost one of the most valuable species in the world. Not only did we lose an animal that provided so much in terms of food, clothing, and shelter, we lost an animal that possibly helped the plants on the prairie. The purpose of this paper is to compare the diversity of forbs on land grazed and ungrazed by bison.

In tallgrass prairie bison grazing increases the plant and species richness. (Knapp, Blair, Briggs, Collins, Hartnett, Johnston, Towne) The increase in plant diversity (particularly forb diversity) leads to higher diversity of other taxa, including birds, small mammals and insects. (Fuhlendorf, Engle) However it is unclear whether bison have the same affect in Palouse Prairie.

Here, I measured the abundance of herbaceous species that are of cultural importance to local Native American tribes. I hypothesize that bison act as a keystone species in Palouse Prairie. Therefore, abundances of certain species will be higher on grassland sites grazed by bison compared to grassland sites where bison are excluded. The uses of each of the four plant species by local Native American tribes are discussed. These forbs studied were Yarrow (*Achillea* *millefolium*,) Wild Rose (*Rosa arkansana*,) (Prairie Sage, *Artemisia frigida*,) and Oyster Flower. (*Mertensia maritima.)*

Field Methods: The National Bison Range is part of the Flathead Reservation. This reservation is home to the Pend D' Oreille and Confederated Salish and Kootenai tribes. Researchers may use this land by obtaining a research permit from the Fish and Wildlife Service.

There were 45 sites. There were 50 plots at each site, for a total of 2250 plots. Most of the sites were in lower elevations. At each site, five 100 feet transects were used. All transects were placed 100 feet apart. Flags were placed every ten feet. At each flag, a .25 meter quadrant was placed at the bottom right-hand corner. In each quadrant, the number of the individual plants for each of the four focal species was counted. These forbs were Yarrow (*Achillea millefolium*,) Wild Rose (*Rosa arkansana*,) (Prairie Sage, *Artemisia frigida*,) and Oyster Plant (*Mertensia maritima*.)

Statistical Analysis: An ANOVA was used to test the hypothesis that forb abundance is higher in bison grazed areas than in bison ungrazed areas.

Results: An ANOVA was used to test the effects of grazing on abundance of these forbs. Contrary to what I had previously read about Bison grazing improving Tallgrass Prairie, Bison grazing does not appear to Palouse Prairie forbs. The P-values were as follows: Yarrow= 0.030, Fringed Sage= 0.003, and Oyster Flower=

0.041. Each of these are significant values, in other words, less than .05. Even more interesting, Prairie Rose, was the only plant which appeared to improve in grazed areas, however, its P-value was 0.359, which was not significant.

Bison grazing significantly affected Yarrow, Sage, and Oyster Flower by decreasing their abundance. (Fig 1-3) Bison grazing did not significantly affect Prairie Rose, however, it did increase their abundance. (Fig 4)

Discussion: Some reasons could be the following: Perhaps Bison trample many Prairie plants.

Perhaps if I had selected more forbs for my samples, I may have had different results. I originally included Prickly Pear and Bitterroot, but found no prickly pear and found bitter root only at only one site.

Except for choosing grazed or ungrazed, my site selection was random. One problem is that in grazed areas I would occasionally run into buffalo wallows. This is where bison typically wallow, (roll around) in the dust and dirt. The bison chose sites where vegetation is usually scarce in the first place and wallow until they are about 15 feet in diameter. They can be up to 10 inches deep and filled with dust. (Schult) The number of plants in wallows is naturally zero. Because my plots on the same transect were 10 feet apart, I would sometimes have two plots on a single wallow, leading to a low count for the transect. When first encountering wallows, I thought about moving to a different site, but then reconsidered because wallows are a natural part of a grazed environment.

The Native Americans who lived here were Pend D' Oreille and Confederated Salish and Kootenai tribes. These are some ways in which they used these various forbs.

Yarrow is important as a hemostatic. The leaves can be put on the wound to stop bleeding that occurs. Usually the bleeding stops within a few minutes. Yarrow contains an alkaloid chemical which pharmacists have extracted from it and in laboratory experiments it reduces clotting time. The Kootenai referred to yarrow as "Chipmunk's tail" because of the leaves. (Hart)

Certain tribes used Wild Rose, which is very high in vitamin C. While Wild Rose is abundant, birds and mice often eat the rose hips before people find it. (Gridley) However, many tribes, like the Cheyenne avoided it, because of a legend about Coyote. Coyote is often a trickster or a cultural hero. One day, Coyote was wandering around and came upon some wild rose. When he ate a rose hip, his anus started to itch. He scratched himself so much that he started to bleed heavily and actually bled to death. Whether this is true or not, and I have my doubts about it, some tribes totally avoided Rose hips for this very reason. (Hart) Had Coyote studied about the properties of yarrow before experimenting with wild rose, he may have prevented his death, and perhaps history would have turned out quite differently. Fringed Sage was often used in ceremonies. It was also used to flavor sausage made from bison, elk, and deer.

I could not find any Native American use for Oyster Plant. However, settlers in this area used it because its roots can be cooked to taste like oysters. Oyster flower is native to the Mediterranean but has been spread throughout the world. There is not much data on this plant. (Wikipedia)

Conclusion: I enjoyed this project tremendously. In the beginning, I approached it totally scientifically. I read scientific articles, used scientific methods for collecting data, and used modern statistics to interpret my data. I than began reading Pre-19th Century Native American Knowledge and some of it clicked with my own data, and some of it clashed. I realized that to write an honest paper, I had to delve into both worlds, and blend things together. This paper could not be called a purely scientific paper. Nor could it be called a paper about Native American Culture. Only when I allowed my mind to open up to new ideas and ways of doing things, was I able to complete this project.

Most of us are accustomed to thinking like scientists- i.e. "The proof of the pudding is in the Statistics." Through parts of this, I had to try to think like a Native American before the 1800s. Their knowledge is real even though it is not written down. Perhaps in our empirical desire for the truth many of us have become a “Doubting Thomas” when it comes to exploring new ideas.

In addition to that, we must take some of the legends Native American legends seriously.   Often Napi represents somebody and was handed down through story-tellers throughout history. (Barsh) These story-tellers were professionals- their job was to orally account for thousands of years of history. It remained the same story for centuries.

For example, when people wanted to design a World Heritage site about Buffalo Jumps called Head Smashed In, they asked Blackfoot Elders for information. The Blacksmith elders told them stories about Napi making a fool of himself while trying to become human. Although other animals and the Old Man (Sun) himself give Napi advice, he is too immersed in his own beliefs and desires to listen to them. (Barsh)

So people designed the center anyway, without paying attention to the Blackfoot stories and as a result, the Blackfoot often compare the designers to Napi. The Blackfoot were hinting at truth, but the designers, not willing to take Blackfoot knowledge seriously, did it their own way instead. “Parks personnel missed the significance of the stories elders chose to tell them. Like Napi, the elders were hinting, Park scientists were not prepared to listen carefully or take Blackfoot knowledge seriously as empirical science.” (Barsh)

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Publication: Name: Human Ecology Publisher: Cornell University, Human Ecology Audience: Academic
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2003 Cornell University, Human Ecology ISSN: 15307069
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Figure 1

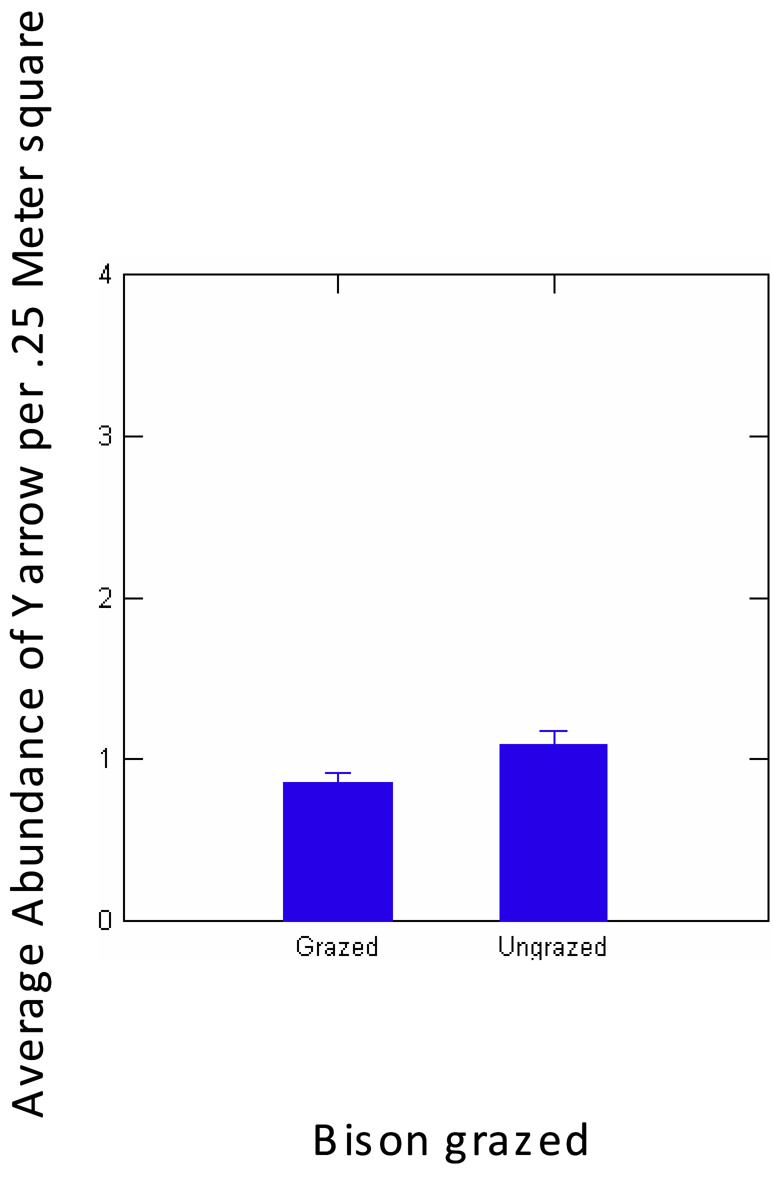
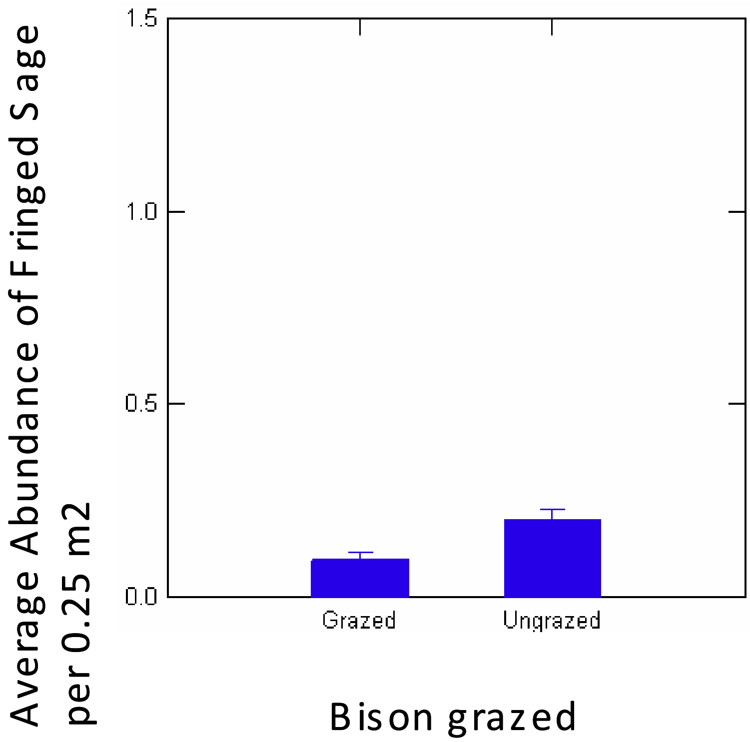
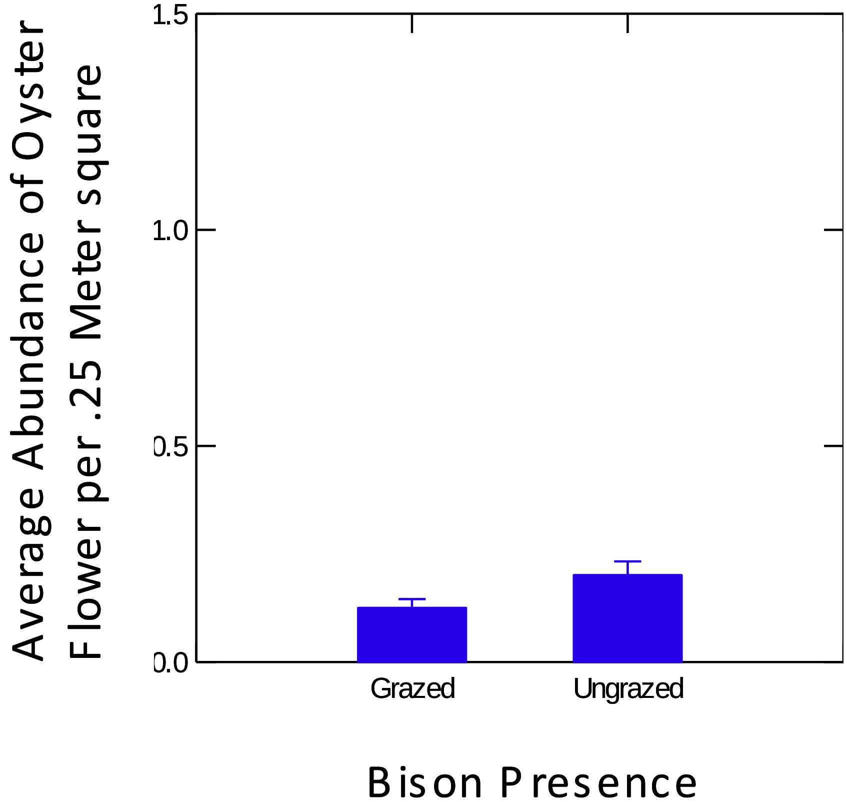

Average Abundance of Yarrow per .25 Meter square
4
3
2
1
0
Grazed
Ungrazed
Bison grazed

Figure 2



Average Abundance of Fringed Sage per 0.25 m2
1.5
1.0
0.5
0.0
Grazed
Ungrazed
Bison grazed

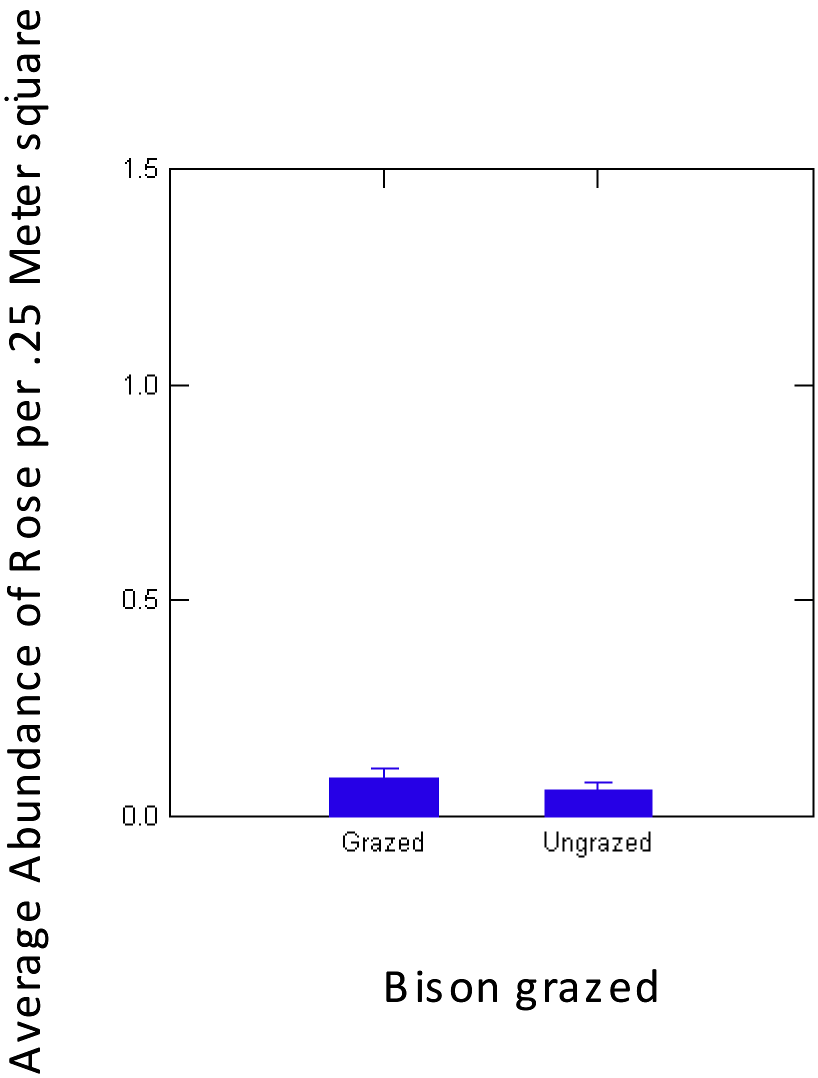
Figure 3



Average Abundance of Oyster Flower per .25 Meter square
1.5
1.0
0.5
0.0
Grazed
Ungrazed
Bison Presence

Figure 4

1.


Average Abundance of Rose per .25 Meter square
1.5
1.0
0.5
0.0
Grazed
Ungrazed
Bison grazed

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
BISON$ (2 levels)	Grazed	Ungrazed

Dependent Variable	OYSTER
N	220
Multiple R	0.138
Squared Multiple R	0.019

Estimates of Effects B = (X'X)$^{-1}$X'Y

Factor	Level	OYSTER
CONSTANT		0.163
BISON$	Grazed	-0.038

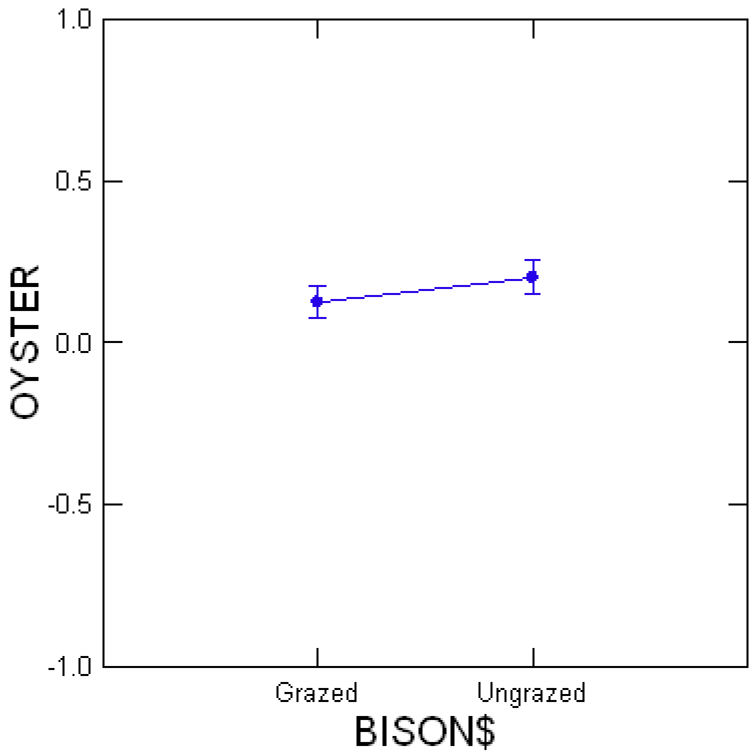
Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
BISON$	0.315	1	0.315	4.235	0.041
Error	16.207	218	0.074		

Least Squares Means

Factor	Level	LS Mean	Standard Error	N
BISON$	Grazed	0.125	0.025	115.000
BISON$	Ungrazed	0.201	0.027	105.000

Least Squares Means



WARNING

Case 133 is an Outlier (Studentized Residual : 4.202)
Case 136 is an Outlier (Studentized Residual : 4.620)
Case 178 is an Outlier (Studentized Residual : 4.100)

Durbin-Watson D-Statistic	1.426
First Order Autocorrelation	0.284

Information Criteria	
AIC	56.529
AIC (Corrected)	56.640
Schwarz's BIC	66.710

▼General Linear Model

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
BISON$ (2 levels)	Grazed	Ungrazed

Dependent Variable	SAGE
N	220
Multiple R	0.201
Squared Multiple R	0.041

Estimates of Effects B = (X'X)$^{-1}$X'Y

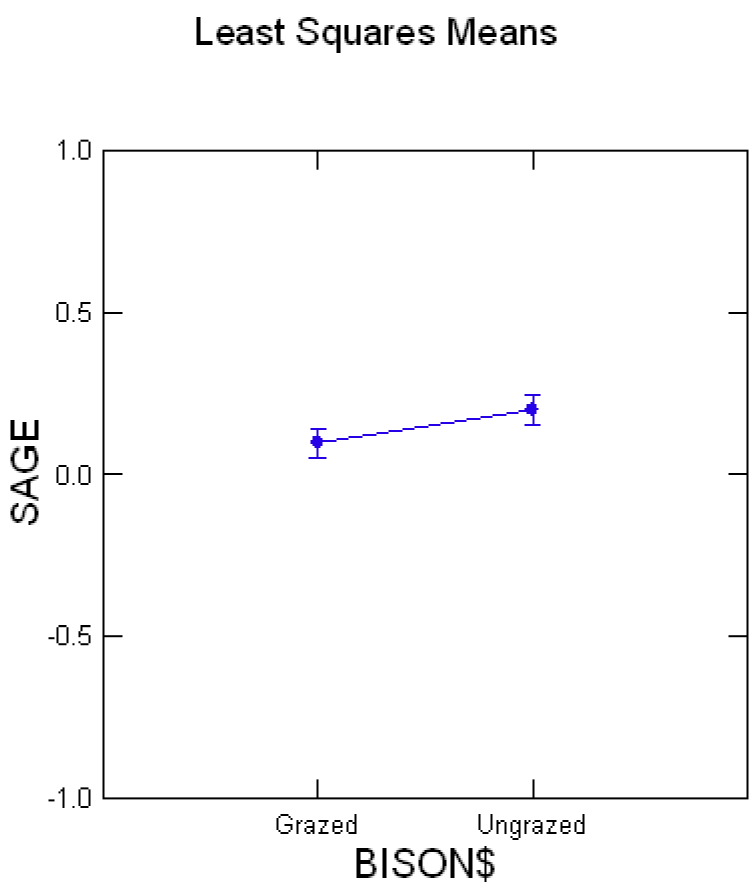
Factor	Level	SAGE
CONSTANT		0.147
BISON$	Grazed	-0.051

Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
BISON$	0.576	1	0.576	9.214	0.003
Error	13.627	218	0.063		

Least Squares Means

Factor	Level	LS Mean	Standard Error	N
BISON$	Grazed	0.096	0.023	115.000
BISON$	Ungrazed	0.198	0.024	105.000



WARNING

Case 47 is an Outlier (Studentized Residual : 4.185)
Case 208 is an Outlier (Studentized Residual : 5.100)

Durbin-Watson D-Statistic	1.377
First Order Autocorrelation	0.308

Information Criteria	
AIC	18.394
AIC (Corrected)	18.505
Schwarz's BIC	28.575

▼General Linear Model

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
BISON$ (2 levels)	Grazed	Ungrazed

Dependent Variable	ROSE
N	220
Multiple R	0.062
Squared Multiple R	0.004

Estimates of Effects B = (X'X)$^{-1}$X'Y

Factor	Level	ROSE
CONSTANT		0.075
BISON$	Grazed	0.013

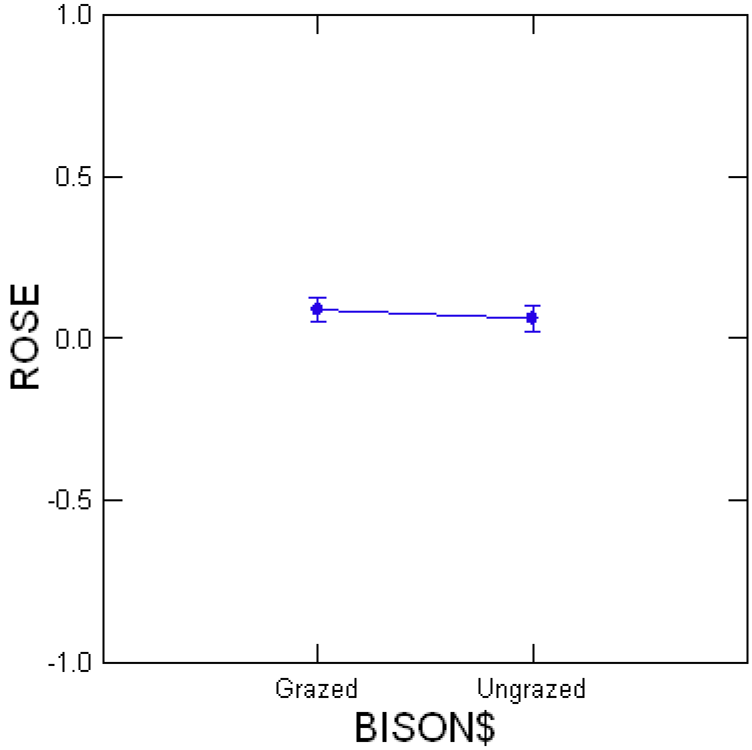
Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
BISON$	0.039	1	0.039	0.847	0.359
Error	10.143	218	0.047		

Least Squares Means

Factor	Level	LS Mean	Standard Error	N
BISON$	Grazed	0.089	0.020	115.000
BISON$	Ungrazed	0.062	0.021	105.000

Least Squares Means



WARNING

Case 36 is an Outlier (Studentized Residual : 5.106)
Case 155 is an Outlier (Studentized Residual : 6.691)
Case 157 is an Outlier (Studentized Residual : 5.512)

Durbin-Watson D-Statistic	1.245
First Order Autocorrelation	0.372

Information Criteria	
AIC	-46.574
AIC (Corrected)	-46.463
Schwarz's BIC	-36.393

▼General Linear Model

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
BISON$ (2 levels)	Grazed	Ungrazed

Dependent Variable	YARROW
N	220
Multiple R	0.146
Squared Multiple R	0.021

Estimates of Effects B = (X'X)$^{-1}$X'Y

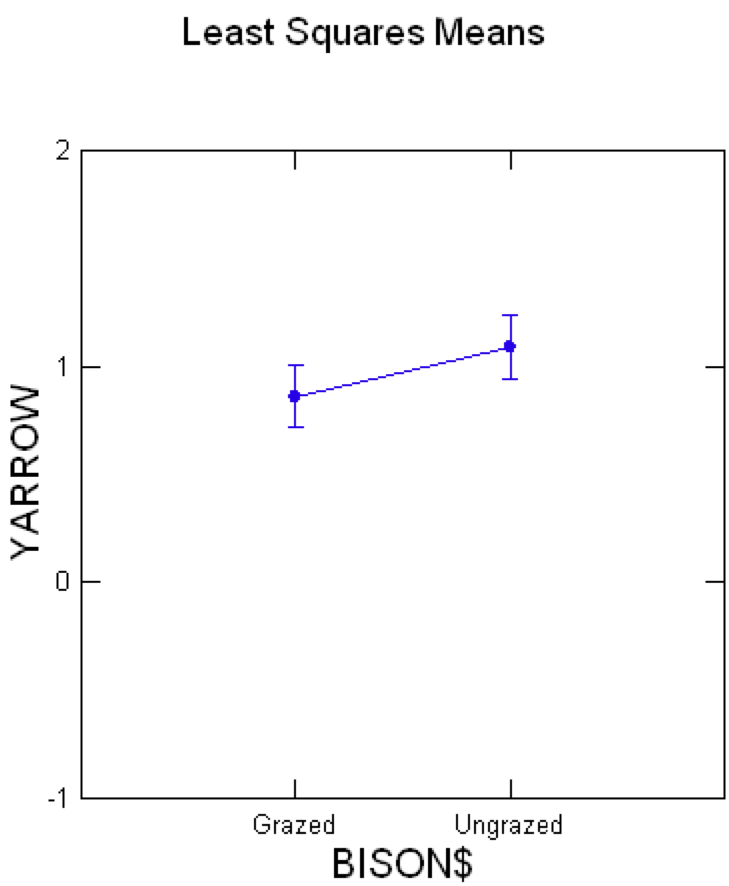
Factor	Level	YARROW
CONSTANT		0.972
BISON$	Grazed	-0.116

Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
BISON$	2.931	1	2.931	4.780	0.030
Error	133.697	218	0.613		

Least Squares Means

Factor	Level	LS Mean	Standard Error	N
BISON$	Grazed	0.857	0.073	115.000
BISON$	Ungrazed	1.088	0.076	105.000



Durbin-Watson D-Statistic	1.312
First Order Autocorrelation	0.337

Information Criteria	
AIC	520.761
AIC (Corrected)	520.872
Schwarz's BIC	530.942

Successfully saved file C:\Users\student\Desktop\SYSTATBISON.syz
Processed 7 Variables and 220 Cases.