Epizoochorous seed dispersal by bison in the Nebraska Sandhills

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INTRODUCTION

Large mammals can assist in the distribution of certain plant species through epizoochory, the external attachment and dispersal of seed-containing propagules. Epizoochoric propagules often have adaptations such as hooks, awns, and/or barbs that can increase the efficiency of seed dispersal by animals (Mori and Brown 1998). Some propagules with no obvious morphological adaptations can also be dispersed by epizoochory (Myers et al. 2004). The height of the propagules has been found to be related to the likelihood of attachment to animal fur (Fischer et al. 1996). In studies conducted in grasslands, the Poaceae (grass) family has contributed the majority of the epizoochorous seeds found in sheep fleece (Milton et al. 1990).

The purpose of this study was to investigate whether the American bison is a vector for epizoochorous seed dispersal in the Great Plains.

METHODS

Study Sites
The present study examined five hides from bison cows which grazed within The Nature Conservancy's Niobrara Valley Preserve in the Nebraska Sandhills. Bison were killed at the preserve in January and transported to the Valentine (NE) Locker where the hides were collected. The hides were frozen until analysis.

Complete Sampling of One Bison Hide
One of the five hides was collected in January 2004, and all of the hair and propagules were removed from thirteen selected sections of this hide (Fig. 1). The propagules were identified and counted in each section of this hide.

Sub-Sampling of Four Bison Hides
Two hides were collected in January 2004 and two were collected in January 2005. Propagules from these hides were removed from 117, 5x5 cm quadrants distributed among thirteen sections of each hide (Fig. 1).

Propagule Identification
Propagules were identified by comparison to known specimens, herbarium specimens, and descriptions from the *Flora of the Great Plains* (Great Plains Flora Association 1986).

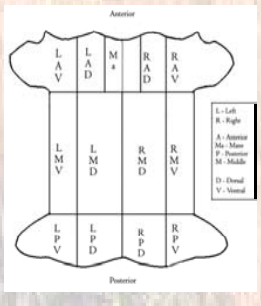

Fig. 1. Bison hide divided into thirteen sections

RESULTS

What species of Nebraska Sandhill plants disperse seeds through epizoochory in the American bison?

Table 1. Total propagules collected from the completely-sampled hide and average plant heights (Great Plains Flora Association 1986).

Species	N	Height (dm)
Andropogon hallii	246	6-15
Helianthus spp.	203	*
Schizachyrium scoparium	169	4-9.5
Bouteloua gracilis/hirsuta	124	1.5-5
Calamovilfa longifolia	105	8-14
unidentified	81	*
Sorghastrum nutans	27	6-20
Bromus inermis	9	4-10
Panicum virgatum	7	5-14
Andropogon gerardii	5	6-14
Vulpia octoflora	5	0.5-4
Buchloë dactyloides	4	0.3-2
Solidago spp.	2	*
Bouteloua curtipendula	1	7-8
Elymus canadensis	1	8-15
Hordeum pusillum	1	1-4
Cenchrus longispinus	1	2-5
Total	989	


A. hallii


B. hirsuta


S. scoparium


C. longifolia

Fig. 2. Poaceae propagules (Utah State University 2005)

Does propagule distribution of the five most abundant epizoochoric species vary from hide to hide or year to year?
Using a Chi-Square test for independence (alpha=0.05) we failed to reject the hypothesis that total seeds found in each hide section were similar in the four sub-sampled hides.

Do propagules attach randomly to bison fur?
Figures 3 a-d show propagules found in the sub-sampled hides. Figures 4 a-b compare propagules found in the completely sampled vs. the sub-sampled hides. Table 2 shows the results of Chi-Square tests (goodness of fit) for even distribution of propagules in the sub-sampled hides.

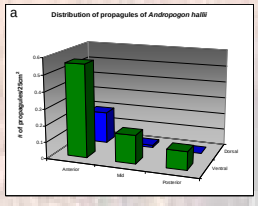

Fig. 3 a-d.

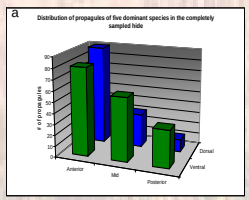

Fig. 4 a-b.

Table 2. Chi-Square test for even distribution of propagules

Species	N	X^2	H_o
Andropogon hallii	110	151.51	rejected
Schizachyrium scoparium	87	55.26	rejected
Bouteloua gracilis/hirsuta	59	36.44	rejected
Calamovilfa longifolia	45	83.73	rejected
Helianthus spp.	16	20.79	not rejected
Total	317		

Fig. 5. Bison in October

Is there a species difference in attachment location on the bison?
Using a Chi-Square test for independence (alpha=0.05) we rejected the hypothesis that the five most abundant species were distributed similarly among the thirteen sections of the sub-sampled hides (see Fig. 3).

DISCUSSION

Propagules from many species were found in the bison fur, with members of the Poaceae (grass) family being most abundant. The five species having the most abundant propagules in the hides are also species that were considered most abundant in Nebraska Sandhills Dune Prairies (Steinauer and Rolfsmeier 2000). However, not all of the species considered abundant in this prairie, including *Eragrostis trichodes, Muhlenbergia pungens,* and *Carex heliophila,* were found in the hides. Many of the species found in the hides have propagules which appear to have adaptations that enhance epizoochory (Fig. 2). Most of the abundant propagules are not evenly distributed on the bison hides. The length of hair in different sections of the hide (Fig. 5) is likely a factor in attachment and retention of propagules (Couvreur et al. 2005). The height of the plant species (Table 1) and their different propagule morphologies may also be adaptations for attachment in differing locations on the bison. Wallowing can incorporate propagules from shorter plants onto dorsal portions of the animal (Fischer et al. 1996).

Many plant species in the Great Plains appear to have propagules which are adapted to epizoochory. The abundance, distribution, and movement of the American bison on the Great Plains may have had a significant impact on the dispersal of these species. Epizoochorous species may be more widely distributed and may be more genetically homogeneous than non-epizoochorous species. Thus, local ecotypes of bison-dispersed species may not have developed in the Great Plains. The significant reduction of epizoochory by bison since the mid-1800's may have implications in the long-term ecological management of Great Plains grasslands.

ACKNOWLEDGEMENTS

We would like to thank the Richard Egelhoff, Bison Manager at The Nature Conservancy's Niobrara Valley Preserve and the Valentine Locker for assistance in obtaining the bison hides.

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