Foraging Ecology of Bison and Cattle

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Widespread access to bison of breeding age in the recent decade has created an alternative to cattle in grassland natural area management. Cattle and bison are considered generalist foragers, yet, differences in food habits indicate that cattle are more selective foragers than bison (Peden et al. 1974). During rut, investment in social interactions should be greater for bison than cattle and might be expected to influence foraging behavior. Foraging by either herbivore may directly influence ecosystem structure and interactions in the biotic community (Ellis et al. 1976).

The challenges facing natural area managers often include recognizing ecological disturbances which are essential (i.e., fire, herbivory) and learning how to implement such processes within fragmented natural landscapes (Steuter et al. 1990). In a natural area context, are bison and cattle analogous herbivores? The paper is a condensation of an earlier report by Plumb and Dodd (1993) and discusses data collected during 1985 to 1987 on a mixed-grass prairie owned and managed by The Nature Conservancy in north-central South Dakota.

Results and Discussion

Diet Composition

In our study warm-season (C₄) grasses accounted for approximately one-third of bison diets early in the season and increased to 40% during late July and all of August. Bison reduced feeding on the warm-season grasses after September 1 to about 15% by September 30. A large increase in cool-season (C₃) graminoid use by bison occurred after September 1, to levels greater than 80%. Total graminoid use consistently increased during early summer, reaching 90% of diets by July. After July, forbs contributed little to bison diets. Browse contribution to diets of bison was minimal (0–3%).

Trends in use of warm-season grasses by cattle were less dynamic. Cattle use of warm-season grasses did not vary from late June through early August. Use of warmseason grasses declined in cattle diets after September 2. Shifts in the amounts of cool season graminoids and total graminoids eaten by cattle occurred biweekly throughout the summer. Forbs contributed 15% and browse contributed near 10% of cattle diets during June and early July. Forb and browse use by cattle decreased in late-July and was maintained at this level for the remainder of the summer. As observed for cattle, seasonal variation in the contribution of graminoids to bison diets also appears to be correlated to seasonal peaks in forage quality (Peden et al. 1974).

There were herbivore by date interactions in amounts of each major forage class contributed to bison and cattle diets. Bison generally consumed more warm-season grasses or cool-season graminoids than cattle from early June through August. Bison always consumed more total graminoids than cattle. Cattle use of forbs was greater than bison from early July through mid-September. Forbs were never less than 5% of cattle diets and peaked in early July at 16%. Conversely, only during June and early July were forbs of any importance to bison diets. Use of browse species by cattle was greater than by bison at five sampling dates from June through mid-September.

Forage Selection

Each herbivore exhibited selectivity by using forage resources out of proportion to availability. Bison and cattle selected for warm-season grasses and against coolseason graminoids during June and August. During August, bison selected against forbs. In June, cattle selected for forbs and browse. However, during August,



Bison at Niobrara Valley Preserve located in North Central Nebraska. Photo by Dr. Carolyn Greigel.

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cattle consumed forbs in proportion to availability while selecting for browse forage.

Time Budgets

There were significant herbivore and month effects for percent time spent grazing per day, duration of grazing periods, and number of grazing periods per day. Cattle allocated more time to grazing than bison during the entire summer. The time cattle spent grazing per day increased rapidly during early to mid-summer, reaching 70% by August. Bison always allocated less time to grazing than cattle, but also increased grazing activities throughout the summer season. Cattle grazing period duration was longer than that observed for bison, yet it is unclear whether observations represent the upper limit for either herbivore. In accordance with seasonally increasing grazing activity of both herbivores, the number of grazing periods decreased.

As total feeding time increases, cattle may allocate greater time to finding a broader array of the nonrandomly distributed forage resource. While allocating greater time than bison to search and feeding activities during early and mid-summer, cattle diets are more broadly based on forbs, browse, and graminoids. As the season progresses towards late summer with increases in senescent standing crop, the bison rut is ending and feeding time allocation becomes less relevant. This is the time that cattle and bison diets should contain most similar levels of graminoids. Our study suggests that the relationship between social time investment (as it influences feeding and non-feeding time partitioning during the rut) and forage patchiness is important in explaining differences in diet choice between bison and cattle.

Implications for Natural Area Management

The appropriateness of bison or cattle for natural area management may depend on the potential of either herbivore to interact within the context of the evolutionary history of the site. In a review of bison-fire-small mammal herbivore relationships on mixed prairie, Steuter et al. (1990) conclude that natural area stewardship independent of the landscape's disturbance history, will strongly limit native community structure and function. An examination of early historical references (1690-1880) suggests that bison grazed heavily on a local scale, which combined with secondary effects such as wallowing. trampling, and rubbing, created a vegetation mosaic (England and DeVos 1969). This literature suggests that prehistoric habitat use patterns of bison regulated different forage classes, altered vegetation structure, and produced variable conditions amenable to other plains ungulates.

Relevant Agents of Stewardship?

It may be incorrect to broadly suggest that because of

their prehistoric role in grassland ecology, bison are the large herbivore of choice for grassland natural area management. We presume that bison reflect to a greater degree the evolutionary context of a grassland natural area. We also presume that differences between freeroaming bison on pristine grasslands and semi-free roaming bison on a fenced natural area must be much greater than those of the latter and domestic cattle.



Bison at Niobrara Valley Preserve owned by the Nature Conservancy. Photo by Dr. Carolyn Greigel.

Inasmuch as changes in grassland structure and function may occur as a result of grazing-related activities, bison and cattle are similarly capable. An assessment of whether bison and cattle are analogous herbivores in an ecosystem context can be evaluated by considering the foraging behavior of these herbivores at various ecological scales. Within a fenced natural area, feeding station/ patch and landscape scales are generally most important. Bison tend to avoid patches dominated by forbs and browse while cattle select more strongly for these forages. This suggests that at the patch scale, bison respond to reduced feeding time per day by maximizing intake of high quality, randomly distributed grasses and graminoids.

Within a landscape large ungulates should select for feeding areas which maximize foraging efficiency. Indeed, both bison and cattle respond positively to relatively coarse patterns of higher forage quantity and/or quality induced by grazing, fire, and seasonal growth dynamics. Whether bison and cattle are analogous in a natural area context is scale dependent. Incorporation of bison and/or cattle into management planning must match these scale dependent goals.

It must also be asked under what programmatic circumstances do semi-free roaming bison or cattle represent appropriate grassland natural area management tools?



Fig. 1.

When considering large ungulates as a stewardship alternative, concerns about herbivore tractability, size of natural area, complexity of management plans, and capital return on investment may become very important. Since bison breeding stock are relatively expensive, an initial investment could be very large. Additionally, disposal of surplus bison requires involvement in a small but highly charged market where outlets and prices vary greatly from year to year. Bison should be a preferred alternative when the natural area is medium to large, economics are acceptable, facilities exist to permit proper handling, and management plans are sufficiently simple so as to preclude very difficult herd manipulations. The actual assessment of the suitability of either herbivore is necessarily case dependent, but major concerns can be estimated as in Figure 1.

In a hypothetical case where natural area size is small, economics are poor, a fire return interval is estimated at five years, and grazing is periodically desired, it seems more reasonable to devote available resources to achieving a proper prescription burn and graze the site with cattle to a desired utilization level on a periodic basis. Where natural areas encompass medium and large tracts, the intimate relationship between bison and grasslands suggests that stewardship with bison may continue relatively uninterrupted throughout the year at a lower stewardship cost per acre. Indeed, stewardship plans encompassing bison and cattle may prove to optimize economic stability and ecological integrity of management.

Summary

The relationship between feeding time investment and forage patchiness appears to be important in determining diet choice of bison and cattle. Both display generalist food habits, exhibiting forage selection while consuming a variety of forages. In contrast to cattle, it appears that bison balance nutrient and time demands by consuming almost exclusively graminoids.

The similarities and differences in the foraging ecology of bison and cattle suggest interesting opportunities for natural area management. When managed to encourage strong social time investment, bison should forage at a feeding station/patch scale primarily on graminoids and impact herbaceous non-graminoids relatively less than cattle. Yet, at the landscape scale, a mixed management model incorporating both herbivores may prove more flexible and appropriate to implement herbivorous disturbance. We suggest that only under certain programmatic conditions does the combination of strong social organization and environmental tolerances (as they influence foraging and fitness) suggest that bison are the most appropriate large herbivore for northern mixed prairie natural area management.

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