MODELING HABITAT PREFERENCES OF CATTLE ON EASTERN OREGON RANGELANDS

Ruben Cruz, David Ganskopp and Martin Vavra

SUMMARY

Three, 2000+ acre native rangeland pastures were selected in the Northern Great Basin Experimental Range to evaluate habitat selection by cattle. Cattle distribution in the pastures was monitored during the periods of May through September in 1996 and 1997. A Global Positioning System (GPS) unit was used to collect cattle locations (UTM coordinates) and activity. A total of 1,776 and 1,974 locations were recorded for 1996 and 1997, respectively. Forage utilization was estimated at 61 randomly placed plats in each pasture in spring 1996 and at the end of the grazing seasons in 1996 and 1997. Cattle distribution was very similar for all three pastures over the 2 years of the study. Cattle use of slope averaging 9.3 percent. Only 49.1 percent of the total number of locations visited were within 0.621 miles of water. We found significant correlations ($P < 0.01$) between previous and current year's utilizations. Correlation coefficients between utilization levels estimated at the beginning of the study and utilization levels at the end of 1996 averaged 0.71 for the three pastures. This correlation increased to 0.84 between 1996 and 1997.

Our results suggest that factors such as slope and distance to water influenced cattle distribution over the landscape, but there were other important interacting factors that lead cattle to follow well established grazing patterns. To be successful, new management alternatives to improve cattle distribution should account for these grazing patterns. Our final goal is to present a test model to describe the most important factors determining large-scale cattle distribution patterns.

INTRODUCTION

Cattle numbers and their grazing effects on public lands are the subject of ongoing controversy. Concern about environmentally sound practices is evident in the growing trend of political involvement, media coverage, conservation policies and environmental concern. Land managers are being required to change their priority of on-ground activities to accommodate multiple use objectives and to emphasize the ecological condition of the land.

Environmental assessment of grazing management plans, however, requires substantive resource data and knowledge of animal behavior. Determining which resources are selected more often than others is of singular importance because it furnishes essential information about the nature of animals and how they meet their requirements for survival. To meet these demands, numerous models to evaluate habitat quality for diverse species have been developed. Using this approach to evaluate livestock habitat provides a framework for predicting and evaluating grazing effects on natural systems. Situations where resource selection studies have a major role include the evaluation of the effect of domestic animals on wildlife habitat.

In recent times, the progression from traditional resource inventory and habitat mapping to the combination of related categories in Geographic Information Systems (GIS) allows for both the use of finer distinctions between land uses and resources and attempts to resolve

conflicts by analyzing the relationships between different types of land use. By combining modeling procedures and GIS technology resource managers will have a means to organize, integrate, and interpret both quantitative and qualitative information that is especially useful for recognizing relationships between herbivores and their environment.

The advantages of predicting domestic livestock distribution and behavior are many. Grazing management plans can be prepared with the certainty that livestock impacts and responses can be reasonably predicted and taken into account. This information can help resource managers to effectively manipulate each land unit according to its potential and best use.

Habitat Use by Cattle.

Cattle distribution on western rangelands is influenced by a complex of factors, including topography, vegetation, climate, water availability, and animal behavior (Sheehy and Vavra 1996). Cook (1966) reported that slope, distance from water, and palatable forage were among the most important factors among 21 variables associated with livestock distribution on mountainous terrain. Management practices, such as seeding of palatable species, brush removal, and salt placement, may attract cattle to underused areas (Roath and Krueger 1982). Under normal circumstances, however, cattle tend to concentrate close to water sources, gentle terrain, and abundant nutritious forage (Smith et al. 1992).

Factors Affecting Habitat Use

Water. Water is a primary habitat requirement of large herbivores. Many authors consider water availability to be a significant factor influencing livestock distribution (Hodder and Low 1978, Vallentine 1989). The heavy use of vegetation around watering points is well documented (Miller and Krueger 1976, Roath 1980). Vallentine (1989) indicated that the movement, distribution, and concentration of grazing animals on medium to large grazing units is highly dependent on the number and distribution of watering places. Recommendations of distance between watering points vary with forage availability, topography, type of animal, and breed of livestock. Goebel (1956) recommended 0.497 to 0.745 miles as the ideal distance between watering points for mountainous terrain in northeastern Oregon. While cattle have been found to travel up to 4.97 miles from water during poor forage years, this can lead to reduced performance (Hodder and Low 1978).

Topography. Under normal circumstances, rugged topography is the second most important cause of poor livestock distribution on rangelands (Holecheck et al. 1989). Cattle prefer relatively level ground over rugged terrain (Gillen 1982). Mueggler (1965), in a study on mountain range in Montana found that percent slope and distance up slope from water accounted for 81 percent of the variation in use of slope by cattle. Ganskopp and Vavra (1987) reported 94 percent of cattle use in eastern Oregon occurred on slopes between 0 and 19 percent. Senft et al. (1983), using regression analysis to predict cattle distribution, determined cattle behavior was largely a function of topography.

Animal Factors. Bailey and Rittenhouse (1989) have suggested that while herbivore grazing

pathways may be constrained by factors such as mobility, barriers, and topography, the cow's decision of where to graze is based on perception, knowledge, and memory of potential choices. Past experience of grazing animals appears to play a prominent role in which sites they graze. Given such abilities, cattle could select nutrient-rich sites more frequently than nutrient-poor sites (Bailey et al.1996). Ganskopp et al. (1992) reported that cattle responded negatively to as few as 3 cured stems in a grass plant. Grazing of plants with 1, 2 and 3 cured stems declined progressively to about 70, 60 and 48 percent, respectively, of higher forage quality, uncontaminated plants (Ganskopp 1991). The formation of groups of animals oriented to specific areas could substantially affect forage use and cattle distribution on the landscape (Platou and Tueller 1985).

STUDY AREA AND METHODS

Three native rangeland pastures were selected in the Northern Great Basin Experimental Range, near Burns, Oregon to evaluate habitat selection by cattle. The total area encompassed by the study area is 6270 acres. This area is divided among ranges 1, 2, and 7, with areas of 2,038, 2,109, and 2,123 acres, respectively. Slopes on the study area range from 0 to 167 percent. Forty cow-calf pairs grazed in each of the three pastures during the periods of May through September in 1996 and 1997. Cattle stocking rates were conservatively estimated based on long-term station records for these three pastures. Five cows in each pasture were fitted with radio collars to help in locating them within the shortest time possible. Cattle were relocated twice a day (morning/afternoon), 4 days/week, and specific locations were recorded with a GPS unit. This provided us with a total of 1,776 and 1,974 locations for 1996 and 1997, respectively. Data collected included cattle locations (Universal Transverse Mercator coordinates), date, time, plant community, and activity (walking, drinking, resting, grazing). These points were exported to a GIS format and used to obtain percent slope, aspect, and elevation at those locations from a digital topographic map. Distance to water was measured from cattle locations, as recorded with a GPS unit, to a single water source for each pasture.

At the beginning of the study, the previous year's forage utilization was estimated by examining sixty one 10-m diameter plots in each pasture for presence and degree of utilization. Data recorded for each included an estimate of the percent of forage removed from each plot, by scoring in one of the following 4 classes: 0 = ungrazed, 1 = 1-20 percent utilization, 2 = 20-40 percent utilization, and 3 = >40 percent utilization. Coordinates for these points were obtained by randomly placing them over the study area in a GIS program and downloading them to a GPS unit for location in the field. Utilization estimates were subsequently obtained at the end of 1996 and 1997 by revisiting the same plots.

RESULTS AND DISCUSSION

Over the last 2 years we have been monitoring cattle selection of habitat on native rangeland pastures. A significant part of this study is to identify how abiotic factors, such as slope and distance to water; and biotic factors, such as animal behavior and forage quality affect cattle distribution. Our final goal is to present a model to describe the most important factors determining large-scale cattle distribution patterns. This study should be completed by August of 1998.

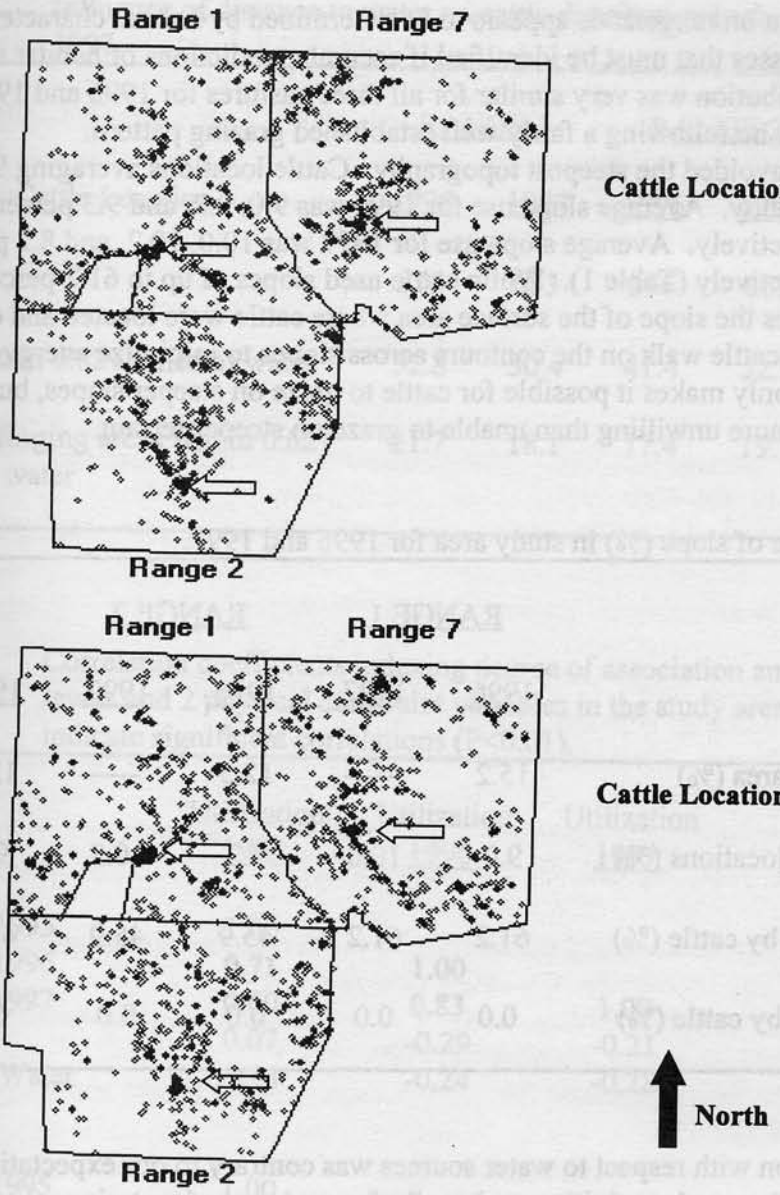

Figure 1. Map of study area showing cattle distributions for 1996 (N=1,776) and 1997 (N=1,974) in 3 pastures on the Norther Great Basin Experimental Range near Burns, Oregon. Arrows indicate location of water source in each pasture

Factors Affecting Habitat Use.

Cattle distribution on rangelands appears to be determined by habitat characteristics and animal behavioral processes that must be identified if accurate predictions of habitat selection are to be made. Cattle distribution was very similar for all three pastures for 1996 and 1997 (Figure 1), indicating that it may be following a fairly well established grazing pattern.

Generally cattle avoided the steepest topography. Cattle locations averaging 9.3 percent over the 2 years of the study. Average slope use for 1996 was 9.0, 9.2, and 9.3 percent grade, for ranges 1, 2, and 7, respectively. Average slope use for 1997 was 10.0, 10.2, and 8.2 percent, for ranges 1, 2, and 7, respectively (Table 1). While cattle used slopes of up to 61.2 percent, this number actually indicates the slope of the surface area where cattle were located and does not account for the fact that cattle walk on the contours across slopes to minimize energy expenditures. This not only makes it possible for cattle to graze on steeper slopes, but also suggests that cattle are more unwilling than unable to graze on steeper terrain.

Table 1. Cattle use of slope (%) in study area for 1996 and 1997.

	RANGE 1		RANGE 2		RANGE 7	
	1996	1997	1996	1997	1996	1997
Average slope of study area (%)	15.2	-----	12.5	-----	12.7	-----
Average slope of cattle locations (%)	9.0	10.0	9.2	10.2	9.3	8.2
Maximum slope visited by cattle (%)	61.2	61.2	45.9	45.9	45.9	42.8
Minimum slope visited by cattle (%)	0.0	0.0	0.0	0.0	0.0	0.0

Cattle distribution with respect to water sources was contrary to our expectations. Many studies have suggested that cattle activities are heavily focused around watering points. However, we found only 49.1 percent of the total number of relocations occurred within 0.621 miles for water over the 2 years of the study (Table 2). Furthermore, when looking at grazing activity, only 19.2 percent of the total locations occurred within 0.621 miles from water. This suggests that while water is a very important factor influencing cattle distribution, other factors such as forage quality and quantity, paired with the animals previous knowledge of a pasture may determine where they actually graze. This became more evident when analyzing the correlations among levels of previous and current years' utilization, % slope, and distance to water (Table 3). Our only significant correlations ($P < 0.01$) were between previous and current year's utilization patterns. Correlation coefficients between utilization levels estimated at the beginning of the study and utilization levels at the end of 1996 averaged 0.71 for the three pastures. This correlation increased to 0.84 between 1996 and 1997 with the same animals in each pasture. We speculate that higher correlations between 1996 and 1997 were a result of the animals' knowledge of the pastures, their preference for areas with less standing dead forage, and the

higher quality of forage in these areas .

Table 2. Influence of distance to water on cattle distribution in the study area for 1996 and 1997.

	RANGE 1		RANGE 2		RANGE 7	
Cattle Location	1996	1997	1996	1997	1996	1997
Total	576	653	596	662	604	659
Percent within 0.621 miles of water	52.8	50.4	41.4	52.9	45.4	51.9
Percent of forging areas within 0.621 miles from water	21.7	18.1	17.4	19.7	17.5	21.0

Table 3. Correlation coefficients indexing degree of association among cattle utilization levels and 2 physical constraint variables in the study area. Numbers in bold indicate significant correlations (P<0.01).

	Utilization 1995	Utilization 1996	Utilization 1997	(%) Slope	Distance to water
RANGE 1					
Utilization 1995	1.00				
Utilization 1996	**0.71**	1.00			
Utilization 1997	0.60	**0.83**	1.00		
(%) Slope	0.07	-0.29	-0.21	1.00	
Distance to Water	-0.01	-0.24	-0.28	-0.52	1.00
RANGE 2					
Utilization 1995	1.00				
Utilization 1996	**0.77**	1.00			
Utilization 1997	0.59	**0.84**	1.00		
(%) Slope	-0.28	-0.34	-0.21	1.00	
Distance to Water	-0.04	0.01	0.01	-0.20	1.00
RANGE 7					
Utilization 1995	1.00				
Utilization 1996	**0.70**	1.00			
Utilization 1997	0.73	**0.85**	1.00		
(%) Slope	-0.25	-0.30	-0.21	1.00	
Distance to Water	-0.06	-0.19	-0.08	0.29	1.00

These previous results suggest that while abiotic factors such as slope and distance to water do influence cattle distribution over the landscape, there are other important interacting factors that lead cattle to follow well-established grazing patterns. Acknowledging that cattle may use past experiences to select grazing sites may be useful in developing new management strategies to modify grazing patterns. New management alternatives to improve cattle distribution could include the use of naive animals, new or additional water sources, and forage conditioning with fire or any other means to alter the structure and quality of the forage stand. Ultimately, it appears that models to predict cattle distribution should include some measure to account for these apparently well established grazing patterns.

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