Agriculture, Ecosystems and Environment 127 (2008) 85–92

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Distribution and interaction of white-tailed deer and cattle in a semi-arid grazing system

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ARTICLE INFO

Article history:
Received 7 December 2007
Received in revised form 29 February 2008
Accepted 6 March 2008
Available online 18 April 2008

Keywords:
Animal interactions
Ecological sites
GPS
Rangeland
Spatial distribution
Texas

ABSTRACT

In order to optimize production, range managers need to understand and manage the spatial distribution of free-ranging herbivores, although this task becomes increasingly difficult as ranching operations diversify to include management of wildlife for recreational hunting. White-tailed deer are sympatric with cattle throughout much of their range and are a valuable commodity in southern rangelands. The spatial distribution of deer and cattle was monitored over 1 year during four trials each lasting 12 days. In each trial six white-tailed deer (three bucks, three does) and nine cows were fitted with Global Positioning System (GPS) collars. Collars were scheduled to take a position location every 5 min to determine animal location. These data were analyzed to study animal-to-animal interactions. To minimize problems of spatial autocorrelation, data were thinned to hourly locations for assessing animal home ranges and distributions. Although there was extensive overlap in spatial distributions of deer and cattle the species exhibited strong temporal separation. The mechanism was probably a combination of avoidance of cattle by deer and different habitat requirements. Close interactions were rare, however, individual deer did not show avoidance of cattle until they were within 50 m of each other. Species distributions overlapped mainly on the most productive ecological sites such as clay loam soils and riparian areas which were favored by both species. Cattle avoided rocky terrain, so deer had almost exclusive use of rocky areas including the productive deep soil drainage areas within them. Does particularly favored these areas and the riparian areas while bucks favored the more open clay loam sites. In this shrub-dominated system both deer and cattle were often located close to ranch roads, and cattle especially used roads as paths of least resistance. Cattle were closely associated with water sources, but deer did not stay long near water or at supplemental feeding sites. Concerns that cattle will displace deer into marginal habitats, or that deer will over utilize vegetation near water and feeders, were not supported.

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1. Introduction

Land use patterns and foraging behavior of wild and domestic herbivores can have long lasting effects on plant community structure and ecosystem function (Hobbs, 1996; Turner et al., 1997), as evidenced by the worldwide problem of shrub encroachment in rangelands. Thus, understanding and managing the distribution of free-ranging herbivores is a major issue facing rangeland managers (Bailey et al., 1996). In many areas the economic value of wildlife on rangeland is becoming increasingly significant (IAFWA, 2002), and revenue from hunting leases often provides a substantial form of additive income to traditional cattle ranching operations (Adams et al., 2000). This has resulted in a changing paradigm of rangeland management, with rangelands increasingly being managed for multispecies production, and in some instances with wildlife production as the primary goal. Successful diversification of ranching operations to include recreational use of wildlife requires further understanding species distributions and interactions. For example, managers of hunting ranches often remove all cattle based on perceived competition between cattle and deer. Yet under light grazing pressure cattle can be a useful tool in creating and maintaining habitat for deer by removing the overburden of dry grass stalks allowing light to reach the soil and stimulate the growth of more nutritious forbs and new grass (Willms et al., 1981; Jenks et al., 1996). Hence, total removal of cattle from deer hunting ranches may not be the most

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0167-8809/$ – see front matter. Published by Elsevier B.V.
doi:10.1016/j.agee.2008.03.004

appropriate management strategy. Identifying key areas of interspecific spatial overlap and non-overlapping areas may allow more accurate multispecies management and greater revenue from the land.

In a synthesis paper on large herbivore grazing distribution patterns, Bailey et al. (1996) considered abiotic factors to be the primary determinants of large scale distribution patterns of herbivores, however, many of the studies of multispecies habitat utilization have been conducted in mountainous areas where terrain and slope have large impacts on animal distribution (Loft et al., 1993; Yeo et al., 1993; Stewart et al., 2002). In relatively flat rangeland, Owens et al. (1991) identified ranch infrastructure, such as roads, fences and water sources, as the dominant abiotic factors influencing cattle distribution, while forage abundance and brush cover were the main biotic factors.

In multispecies management, interspecific interactions may influence habitat use if sympatric species compete for space or food resources. Cattle have been shown to displace elk (*Cervus elaphus*) from meadows and other open habitats, but they have less effect on the distribution of browsers such as mule deer (*O. hemionus*) inhabiting the same area (Wallace and Krausman, 1987). Although cattle and mule deer overlap in distribution within pastures, they are usually temporally separated due to avoidance behavior by the deer (Loft et al., 1993), cattle seem to be indifferent to the presence of deer and are not aggressive towards them (Krämer, 1973; Loft et al., 1993). White-tailed deer are reputedly less tolerant of cattle than are mule deer (Krämer, 1973). Density of cattle also has an effect on spatial interactions, for example in Texas white-tailed deer were seen to share the range with cattle in a continuous grazing system but avoided concentrations of cattle in short duration grazing rotations (Cohen et al., 1989).

Despite this body of knowledge, little is known about the interaction between deer and cattle in shrub-dominated rangelands and how these interactions affect spatial distribution of ungulates in large pastures. The goal of this study was to examine the distribution and interaction of cattle and white-tailed bucks and does in relation to ecological sites, and anthropogenic features such as roads, water sources and localized food resources (high protein supplements provided for deer in free-choice feeders). Use of GPS (Global Positioning System) collars eliminated any confounding effects of human presence altering animal distributions. Our hypotheses were: (i) cattle and white-tailed deer would be temporally separated by deer avoiding close contact with cattle; (ii) cattle and deer would be spatially separated by ecological site due to different dietary requirements, although spatial overlap would be most likely on the more productive sites; and (iii) distributions of deer and cattle would be different with respect to anthropogenic features, cattle should stay close to roads and water sources while deer, as a hunted species, should have limited contact with features frequented by humans.

2. Methods

2.1. Site description

The study was conducted on a 6764 ha ranch, in Uvalde County, Texas (29°15′0.02″N, 100°5′54.01″W) located in the transition zone between the Edwards Plateau and South Texas Plains ecological regions. Vegetation and management practices on the ranch were typical of much shrub-dominated rangeland. Most of the topography of the ranch consisted of gently undulating caliche ridges with thin calcareous soils of low productivity (Stevens and Richmond, 1970), the terrain became increasingly stony towards the northeastern corner of the ranch. Typical vegetation consisted of mixed thorn shrub community containing guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), and cenízo (*Leucophyllum frutescens*) shrubs, interspersed with prickly pear cactus (*Opuntia lindheimeri*). Grass cover was sparse but included red grama (*Bouteloua trifida*) and Wright's threeawn (*Aristida purpurea*). Low lying areas of the ranch contained deeper clay loam soils. These more fertile, relatively flat, areas supported scattered honey mesquite (*Prosopis glandulosa*) trees and a mixed shrub community which included whitebrush (*Aloysia gratissima*) and Texas persimmon (*Diospyros texana*). Trees, such as honey mesquite and live oak (*Quercus virginiana*), were associated with deeper soils and drainages. Grasses included common curly-mesquite (*Hilaria belangeri*), buffalo grass (*Buchloe dactyloides*) and Texas wintergrass (*Stipa leucotricha*). In all areas diverse forb cover varied with rainfall pattern and abundance.

The climate was semi-arid and precipitation patterns were erratic. Mean annual rainfall was approximately 620 mm, but during this study annual precipitation measured on the ranch was above average (883 mm) in 2004 then declined to far below average (180 mm) in 2006. Average annual maximum and minimum temperatures were 35.5 °C and 13.7 °C, respectively.

Within the ranch, this study focused on a 2091 ha pasture delineated by an ephemeral river and steep terrain on the southern side and by high fencing on the other three sides, thus restricting animal dispersal. After the first trial a low fence, excluding cattle from the riverbed and adjacent riparian areas was completed, this restricted cattle but not deer to a 1211 ha pasture. The river was not a barrier to deer movements, for most of the year the only surface water was in two semi-permanent pools and most of the water flowed subsurface through the limestone cobbles. Cattle stocking rate within the pasture was 1 cow–calf unit to 35 ha. Deer density was approximately 1 animal per 6 ha. Within the 1211 ha pasture cattle and deer had access to water at three sites, deer had access to an additional three sites across the cattle fence. Supplemental feed in the form of soybeans was provided year round for the deer at six free-choice feeders, cattle were fenced out of these feeders. Once a week the cattle received a supplement of 20% protein range cubes (Livengood Feeds, Lockhart, TX) fed on the road where ever they were located. Since there was no set feeding location, and usually no feed left after the cattle departed, this practice was unlikely to affect deer distribution. In the last trial frequency of supplementation of cattle was increase to twice a week due to drought induced decline in forage quantity and quality. In hunting season (November through January) a little shelled corn was fed at dawn and dusk at 12 additional sites and scattered on the roads to increase visibility of the deer.

2.2. Experimental design

Spatial distribution of deer and cattle was monitored during four trials each lasting 12 days. Trial 1 ran from 23 July to 3 August 2005, this was in summer of a high rainfall year with ample forage available for the animals; trial 2 ran from 5 to 16 November 2005 in late fall when food availability was declining, this trial was during deer hunting season; trial 3 ran from 8 to 19 March 2006 and was scheduled for spring green up although vegetative production was limited by lack of spring rains; trial 4 ran from 15 to 26 July 2006 in summer during drought conditions when little high quality natural forage was available.

Six adult deer were fitted with GPS collars (Lotek GPS 3300S with drop-off latch, Lotek Wireless, Inc., Newmarket, Ontario, Canada) and nine adult cross-bred Angus cows were also collared (Lotek GPS 3300LR). Due to possible gender specific differences in habitat requirements (Kie and Bowyer, 1999; DePerno et al., 2003) and hunting pressure, we considered bucks and does separately.