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Applied Animal Behaviour Science 63 (1999) 259–267

APPLIED ANIMAL BEHAVIOUR SCIENCE

A note on the behavior of feral cattle in the Chihuahuan Desert of Mexico

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Accepted 3 February 1999

Abstract

Habitat use and behavior of three feral cattle were compared to three domestic cattle in the Mapimí Biosphere Reserve, Chihuahuan Desert, where approximately 1000 feral cows were found on 151,000 ha. Feral cattle were found to represent an ecotype adapted to desert conditions. In comparison with domestic cattle, feral animals lived in small group sizes (1–20 animals), had larger home range sizes ($\bar{x} = 47$ vs. 14 km^2), traveled longer distances hourly ($\bar{x} = 1$ vs. 0.3 km/h) and daily ($\bar{x} = 20$ vs. 7 km/day) and used more kinds of habitats than domestic cattle. Seasonally feral cattle used different kinds of habitats in comparison to domestic cattle which intensively used ephemeral streams throughout the year. Anti-predator strategies in response to hunting by local ranchers are thought to explain the pattern. We suggest this pattern of habitat use could minimize the impact of cattle on desert environments.

Keywords: Free ranging animals; Cattle: feral; Cattle: spatial distribution

1. Introduction

Feral cattle have been studied in several regions of the world (Lesel, 1969; Reinhardt, 1982; Kimura and Ihobe, 1985; Hall and Moore, 1986; Vitale et al., 1986; Daycard, 1990; Lazo, 1992). However, these studies were conducted in temperate or tropical

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0168-1591/99/$ - see front matter
PII: S0168-1591(99)00015-5

ecosystems and they were situated on islands or in small areas. To date, no information exists on the behavior of feral cattle in desert environments. To provide such data, we conducted a study of habitat use and movement patterns of feral cattle in Chihuahuan Desert of Mexico.

Jarman (1974) showed that nutrition (food and water) and predation are determinant factors explaining the social organization and use of habitat of wild ungulates in Africa. In general, large wild ungulates are not selective in their diet and live in large size groups to minimize predation risk (Jarman, 1974). The works of Carbyn and Trottier (1987) and Komers et al. (1993) supported this thesis, showing that in bison (*Bison bison*), large groups minimized predation risk. Additionally desert mammalian species have to adapt different strategies to obtain water and to minimize its lost by evapo-transpiration. They often will be active and drink at night or eat forage with high water contents (Sinclair, 1977; Hervert and Krausman, 1986; Williamson and Delima, 1991; Owen-Smith, 1992; Nagy, 1994).

Based on the above, our hypothesis is that the behavior and habitat use of feral cattle in the Chihuahuan Desert is similar to wild large ungulates. They should be generalists, live in large herds, and be nocturnal. Our approach to test this was to compare patterns of habitat use and behavior between domestic and feral cattle. We measured home range size, habitat use and use patterns, movement patterns, and group sizes of feral and domestic cattle.

2. Study area

We conducted this study in the Mapimí Biosphere Reserve, located in the Mexican states of Coahuila, Chihuahua and Durango (Fig. 1). The Reserve is in a flat region (1100 m above sea level) surrounded by mountains ranging in altitude to 1680 m above sea level. Annual rainfall is about 254 mm and mean low and high temperatures are between 12 and 28°C. The study area was in the southeast part of the Reserve, an unfenced area (151,500 ha) that normally contained approximately 1000 feral and 6000 domestic cattle. There are 10 specific habitat types within this area (Table 1). The most abundant plants are creosotebush (*L. tridentata*), mesquite (*P. glandulosa*), prickly pear (*O. rastrera*), ocotillo (*F. splendens*), and tobosa grasses (*H. mutica*). The Reserve also has 10 water reservoirs ranging in size 103,000 to 1,900,000 m^3.

Feral cattle in the area originated from two possible introductions. The first in the 17th century and the second in the 1970s (Hernández et al., 1996). Ranchers use a mixture of breeds consisting of Brahman (*Bos indicus*) with Charolais (*Bo. taurus*) and Brangus (*Bo. indicus* × *Bo. taurus*). In the study area, the domestic cattle are intensively managed for calf production while the feral cattle are occasionally chased and captured to be sold to local markets.

3. Methods

Five feral and three domestic adult female cows were randomly selected from different herds. They were captured and equipped with radio-collars (Telonics) in the

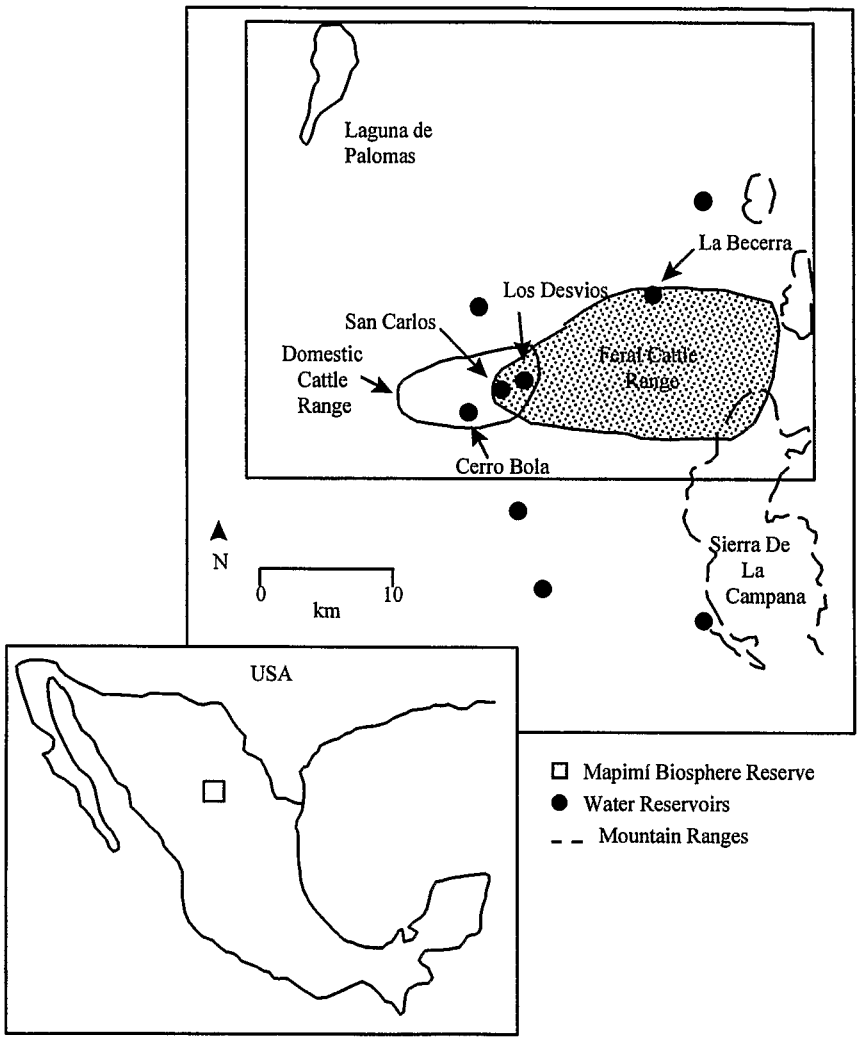

Fig. 1. Map of Mapimí Biosphere Reserve, with areas used by domestic and feral cattle.

151-MHz range. The collared animals remained in their respective groups during the study. Thus the data from the collared animals represented the behavior of eight separate groups of cattle rather than just eight individual animals.

We located animals by triangulation of two consecutive bearings obtained with a yagi antenna. Previous to beginning the study we estimated our triangulation error to be 5°. We triangulated animal locations hourly over 24-h periods. Based on weather patterns, we divided the year into three climatic seasons: hot/dry (April–June), wet (July–October), and cold/dry (November–March).

Home range size was determined by the Kernel method (Worton, 1989). For this analysis the outlying 10% of the data points were excluded. Hourly movement patterns

Table 1
Characteristics of each type of habitat found in the study area and whether they were preferred by feral or domestic cattle

Habitat	Topography	Soils	Dominant plant species	Area (km^2)	Preferred by DC or FC[a]
H1	upper slopes	calcareous	*Bouteloua gracilis*		
			Fouquieria splendens		
			Erioneuron pulchellus	59.75	FC
			Yucca torreyi		
H2	lower slopes	calcareous	*Atriplex acanthocarpa*		
			Prosopis glandulosa	32.5	FC
H3	ephemeral streams	sandy clay	*Hilaria mutica*		
			P. glandulosa	27.25	DC and FC
H4	foothills	calcareous	*Acacia constricta*	1.75	
H5	hills	conglomerate	*Agave lecheguilla*		
			Agave asperrima	6.25	
H6	lower slopes	sandy clay	*H. mutica*		
			Larrea tridentata		
			P. glandulosa	99.75	FC
H7	mountains	conglomerated stones	*A. asperrima*		
			A. lecheguilla		
			Euphorbia antisiphilitica		
			F. splendens		
			Hechtia glomerata	9.25	
H8	slopes	volcanic	*F. splendens*		
			Opuntia rastrera	14.75	
H9	slopes	clay	*H. mutica*		
			P. glandulosa	4.75	DC
H10	mountains	stones on volcanic rocks	*H. glomerata*	1.25	

[a]DC = domestic cattle, FC = feral cattle.

of cattle were expressed as straight line distance moved between hourly locations. Total daily distance was the sum of the hourly distance measurements. Differences in home range size and daily distance traveled between cattle type was tested with a group *t*-test.

Habitat use was assessed by superimposing the hourly locations onto a vegetation map (scale 1:50,000) with grid cells of 250×250 m. Use of a particular habitat type was assessed by estimating the frequency of occurrence of locations within the grid cells containing that habitat type. Patterns of each habitat use were assessed on both a daily and seasonal bases.

To evaluate habitat preferences or avoidances we use the *G*-test (Sokal and Rohlf, 1981). We adjusted expected frequency of occurrence relative to habitat availability. We used the method proposed by Neu et al. (1974) to establish confidence intervals for the number of times that animals used each type of habitat. To test seasonal differences in use of habitat we used a GLIM model (Heisey, 1985).

We collected information on group size of group during 30 visits to the areas where feral cattle lived. We formed five classes of group size: (1–5), (6–9), (10–20), (21 to 50) and 50 or more animals.

Between May 1990 and December 1993, we obtained 1132 locations for the eight cows. For two feral cows we had only eight and 58 locations. These animals moved to roadless areas within and outside of the Reserve where tracking was difficult (Hernández et al., 1998). For the other six cows we had 135 to 304 locations. These locations represent a minimum of five and a maximum of 12 and 24 h monitoring sessions (two to four per season). The results presented here are for these six cows.

4. Results

4.1. Home range size

The mean annual home range size for feral cattle was 46.6 ± 2.6 km^2 and was significantly larger than the mean for domestic cows (13.9 ± 2.2 km^2) ($t = 11.2$, $df = 4$ 4, $P < 0.001$). Within each of the three seasons home range size of feral cattle were 4 to 15 times larger than those for domestic cattle. Within cattle type, home range sizes of feral cattle for the two dry seasons did not appear to differ and were combined ($\bar{x} = 49.5 \pm 1.2$ km^2). This estimate was three times larger than for the wet season ($\bar{x} = 17.1 \pm 5.8$ km^2) however the small sample size precluded us from determining if this difference was significant. The home ranges of the domestic cattle did not seem to vary seasonally.

4.2. Habitat use

Relative to spatial use on the Reserve, the feral cattle primarily used the eastern region which included the highest mountains and the water reservoir (La Becerra) most distant from human activity and extended to the San Carlos water reservoir (Fig. 1). The domestic cattle concentrated their activity in a small area around each one of the three reservoirs (San Carlos, Los Desvios, Cerro Bola) (Fig. 1). Of the 10 habitat types that occurred in the study area, there were different preferences between feral and domestic cattle (Table 1). Feral animals used more diverse habitats including mountains slopes (H1, H2, H6) and ephemeral streams (H3). Domestic cattle concentrated their use in moist areas (H3) and food plains (H9). These two areas have the same dominant species: tobosa grasses and mesquites. In contrast, the habitats used by feral cattle had more diversified vegetation (Table 1).

There were seasonal use patterns by feral cattle but not by domestic cattle (Table 2): in the wet season feral cattle only used habitat H6 which was the sandy clay lower slopes (Table 1). In this season this habitat contained a high diversity of annual grasses. In the cold/dry season they again used H6 but in addition used H1 (calcareous upper slopes, Table 1). This habitat (H1) has two dominant species of perennial grasses (*B. gracilis* and *E. pulchellus*) and two dominant woody plants (ocotillo and *Y. torreyi*). H6, in this season has only tobosa grasses and mesquite. In the driest season (hot/dry), they used four types of habitat H1, H2, (calcareous upper and lower slopes), H3 (ephemeral streams), and H6. Ephemeral stream (H3) areas are the most fresh habitat in this season and drain through the wide areas of H6 to the water reservoirs of La Becerra and San Carlos.

Table 2
Seasonal differences in the home range size, mean traveled distances and habitat preferences by feral and domestic cattle (data from Montaña, 1988)

Kind of cattle	Season	Home range size (km^2)	Mean traveled distances (km/day)	Habitat preferences[a]
Feral	hot/dry	48.2+3	25.3	H1 (19%)
				H2 (27%)
				H3 (23%)
				H6 (27%)
	wet	17.2+3	18	H6 (39%)
	cold/dry	50.8+4	8.8	H1 (36%)
				H6 (31%)
Domestic	hot/dry	3.6+3	6.4	H3 (24%)
	wet	4.7+3	5.4	H3 (77%)
	cold/dry	3.4+3	7.7	H3 (34%)
				H9 (42%)

[a]See Table 1.

Domestic cattle used habitat H3 in all three seasons. In the cold/dry season, besides H3, they used H9 (flood plains Table 2), which has similar vegetation of H3. In general, domestic cattle concentrated their activity around the water reservoirs (San Carlos, Los Desvíos, Cerro Bola).

Both types of cattle used the habitat in different manners between day and night. Of the three major habitats used by feral cattle (H1, H2 and H6), the first two, located near of Sierra de la Campana mountains, were used more during the day (27% and 29%) than at night (23%, 16%). Habitat type H6 was used more at night (36%) than the day (28%) and was the most used night time habitat. This habitat type is located near the water reservoirs. In both night and the day, domestic cattle primarily used H3 (ephemeral streams). However, they used this habitat type more at night (73%) than the day (51%).

4.3. Daily and hourly travel patterns

Average daily travel for feral cattle was significantly longer (20.3 ± 1.5 km/day) than for domestic animals (6.6 ± 0.6 km/day) ($t = 6.78$, $df = 4$, $P < 0.001$). Feral cattle also exhibited differences in daily travel among seasons (Table 2). Daily displacement in the hot/dry season ($\bar{x} = 25.3 \pm 2.9$ km) was longer than for the wet season ($\bar{x} = 18 \pm 2.3$ km) and the cold/dry season ($\bar{x} = 8.8 \pm 3.1$ km). Again, limited sample size precluded us from determining if these differences were significant. There were no differences in travel distances among seasons for domestic cattle.

Because feral cattle traveled greater distances in general (Table 2), the average hourly displacements (1.0 ± 0.1 km/h) were greater than the domestic cattle (0.3 ± 0.04 km/h). These differences however were most pronounced between the hours of 2200 to 0200 h. In this period feral animals traveled the highest average distance of 1.4 km/h and we recorded the maximum distance of 6.4 km in 1 h. Domestic cattle had their

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4.4. Group size

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5. Discussion

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elephants (*Loxodonta*
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higher average travel distances between 1100 to 1600 h ($\bar{x} = 0.5 \pm 0.06$ km/h) and had their maximum average of 0.7 km at 1600 h.

4.4. Group size

We observed 113 groups of cattle in the area that was used by feral cattle; 65% of these groups were seen during the day and 35% at night. A total of 54% of the groups are formed by one to five animals, 29% were groups of six to 10 animals, and 15% were groups from 11 to 20 animals. The domestic cattle were normally (90%) in groups greater than 50 animals but never less than 30 (10%) and remained around the water reservoirs during the day.

5. Discussion

Although the number of collared animals we studied was limited, their behaviors did represent the six different groups of cattle to which they belonged. Based on this, we concluded that feral cattle in Mapimí were behaving different then domestic cattle: they lived in smaller group sizes, had larger home range sizes, used a greater diversity of habitat overall and seasonally, and traveled larger distances, especially at night. These differences could possibly be explained by the feral cattles' need to balance obtaining water and food (different grasses and woody plants in each season) against protection from predation.

Relative to nutrition, the small group sizes found could possibly have provided the feral cattle a nutritional advantage by reducing intra-group competition and use of a greater diversity of habitat patches. In contrast, for the females, this could have an anti-predator disadvantage in that their calves could be more vulnerable to predation by coyotes (*Canis latrans*) or mountain lions (*Puma concolor*). A larger group size then might seem a more appropriate anti-predator behavior (Jarman, 1974; Carbyn and Trottier, 1987; Komers et al., 1993). However, in Mapimí, man is the main predator of the feral cattle. If found in flat open areas, especially near the reservoirs, these cattle were often chased by ranchers on horseback, captured and sold to local markets. In this instance, large groups would be disadvantageous, making it easier for ranchers to locate and capture more animals. We speculate that the feral cattles' use of steep rocky areas (H1) and areas with a high cover of trees (H2) during the day was to reduce further this predation risk.

At night, the feral cattle traveled long distances through open areas (H6) to get to the water reservoirs. To drink at night may have an advantage in reducing water lost by evapo-transpiration. We contend again, however that because the feral cattle differed from the domestic cattle in this regard, their nocturnal behavior is also in response to the predation pressure by ranchers. This behavior is similar to that seen in buffalo bulls in Africa to avoid lions (*Panthera leo*), (Prins, 1989, Prins and Iason, 1989), or forest elephants (*Loxodonta africana*) (Tangley, 1997) and mule deer (*Odocoileus hemionus*) (Boroski and Mossman, 1998), who they switched their behavior to avoid hunting by humans. Consequently, the most logical explanation for the differences seen between the

behavior of feral and domestic cattle in Mapimí is the predation pressure by local ranchers.

This switch in behavior of feral cattle in response to predation risk could reduce their impact on the desert environment compared to domestic cattle. The impact of feral cattle is spread over a large area while domestic cattle, with their concentrated and intensive use of a specific habitat type (H3) could severely impact these areas. Thus, the maintenance of feral cattle could represent a possible way to reduce the impact of cattle on a desert environment.

Acknowledgements

This study was supported by Départément MAA-ORSTOM (France) and by Instituto de Ecología, A.C. Centro Regional Durango. The authors are grateful to Dr. A. Cornet, the former and present directors of the ORSTOM in Mexico: Drs. M. Porter, C. Dejoux, and H. Pouppon for their assistance and specially to the 'Las Tortugas Vaqueros' in Mapimí for their help in the field. Dr. J.W. Laundré helped in the English translation.

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