



# Association patterns of visually-observed cattle on Montana, USA foothill rangelands



Mitchell B. Stephenson<sup>a,\*</sup>, Derek W. Bailey<sup>b</sup>, Delyn Jensen<sup>c</sup>

<sup>a</sup> University of Nebraska-Lincoln, Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361, USA

<sup>b</sup> Department of Animal and Range Sciences, New Mexico State University, Box 30003, Las Cruces, NM 88003, USA

<sup>c</sup> Northern Agricultural Research Center, Montana State University, 3848 Fort Circle, Havre, MT 59501, USA

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## ABSTRACT

Cattle on extensive rangelands typically graze in smaller groups rather than as one large herd. The objective of this study was to examine the strength of social associations among cattle in different sized herds. Associations among individual pairs of cows (i.e., dyads) on rangelands were determined from 12 to 15 early-morning visual observations during the summer months from 1997 to 2001. Strength of associations was assessed at group (i.e., cows that were within 30 m of other cows) and pasture section (i.e., cows within the same general pasture area) spatial scales by determining Half-Weight Index (HWI) association values for all dyads with the association software program SOCPROG 2.4. Herds with 40 or less cows exhibited association patterns that were not different ( $P < 0.95$ ) from what would be expected by chance suggesting that cattle in herd sizes of 40 or less did not exhibit preferential or avoidance associations. In contrast, cattle in larger herds (i.e., 53–240 cows) tended to form associations with other cows that were stronger or weaker than what would randomly be expected. Strengths of associations at the group scale in larger herds were typically low with most pairs of cattle only being observed together in the same group in less than 30% of the observation periods. At the pasture section scale, cattle appeared to have relatively strong associations, but it was unclear if this was an affinity to the same pasture area or a strong social bond with herd mates. Differences in association patterns at different herd sizes suggests that social behaviours observed in small herds may not fully reflect the natural associations that occur with larger herds of cattle on rangelands.

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## 1. Introduction

Cattle on extensive rangelands are typically observed grazing in small groups rather than as one large herd (Dwyer, 1961; Muller et al., 1976; Roath and Krueger, 1982; Lazo, 1994; Howery et al., 1996; Harris et al., 2007). Grouping behaviour among beef cattle is likely the result of evolutionary benefits including protection from predators, increased opportunities for synchronized breeding, group rearing of young, and thermoregulation (Estevez et al., 2007; Laca, 2009). Social learning as a result of gregarious behaviour also facilitates the transfer of information for location of feeding sites, water, and cover in extensive rangelands (Launchbaugh and Howery, 2005). In resource limited environments, benefits of grouping behaviour may come at the expense of increased competition for food and other resources (Estevez et al., 2007). While

cattle exhibit grouping behaviour, less is known about how individuals choose their group of associates and the strength of these associations in typical beef cattle ranches on extensive rangelands.

Feral cattle on rangelands have been observed associating within fusion-fission societies (Lazo, 1994). Cattle in this study formed into distinct and stable home range groups at large spatial scales based on familial associations or strong social bonds, but social organization of individuals at smaller spatial scales was unstable, and smaller groupings of cattle consistently changed in size and composition depending on food abundance and other ecological factors (Lazo, 1994). Reinhardt and Reinhardt (1981) indicated that familial relationships facilitated stable group formation within herds of semi-wild Zebu cattle when calves were kept with the herd over 5 yrs. Familial bonds appear to be the basis for natural grouping of cattle when there is little interference from human management.

However, beef cattle husbandry practices often limit formation of familial bonds by weaning of calves at 6–8 months of age, managing heifers separately from the main herd, and

\* Corresponding author.

E-mail address: [mstephenson@unl.edu](mailto:mstephenson@unl.edu) (M.B. Stephenson).

**Table 1**  
Pasture and herd size, stocking density, number of cattle used in the analysis, and number of observations of cattle grazing the Rakes pastures from mid-June to late-July and the Back pasture late-July to early-September from 1997 to 2001. Rakes and Back pastures were divided into East and West subdivisions prior to the grazing season during 1999–2001.

Pasture within year	Pasture size (ha)	Herd size	Stocking density (ha cow <sup>-1</sup> )	Number of cows used in the analysis	Number of visual observations
1997					
Rakes	159	53	3.0	53	12
Back	337	234	1.4	234	12
1998					
Back	337	240	1.4	240	12
1999					
East Back	176	110	1.6	106	12
West Back	161	119	1.3	111	12
East Rakes	81	75	1.1	75	13
West Rakes	78	79	1.0	76	13
2000					
East Back	176	111	1.6	110	12
West Back	161	109	1.5	102	12
East Rakes	81	39	2.1	39	14
West Rakes	78	40	2.0	39	13
2001					
East Back	176	103	1.7	99	13
West Back	161	99	1.6	96	14
East Rakes	81	29	2.8	27	14
West Rakes	78	27	2.9	27	15

mixing herds of cattle (Veissier et al., 1990, 1998; Mench et al., 1990; Boe and Faerevik, 2003). Under typical western USA ranching conditions, Howery et al. (1996) reported that crossbred beef cattle showed fidelity to specific home ranges, but did not form strong social associations. Similarly, Hereford cow-calf pairs on Oklahoma rangelands formed groups at water, salt placements, or during grazing, but the composition of individuals within these groups was not consistent and group memberships were often variable (Dwyer, 1961).

Previous research that has documented associations among individual beef cattle were often based on observations of cows within small herds (Hacker et al., 1988; Harris et al., 2007; Bailey et al., 2010; Finger et al., 2014), and only a few studies have evaluated associations with herds of more than 100 cows (Dwyer, 1961; Howery et al., 1996). Studies using larger herds may be necessary to fully evaluate the grouping dynamics and social association behaviours of cattle managed on extensive rangelands (Laca, 2009). Understanding the social association dynamics and group formation of beef cattle is an important component for management of grazing distribution on rangelands (Skovlin, 1957; Sowell et al., 1999). Determining the strength of associations among beef cattle may help us discover the potential impact of social associations on the efficacy of using different herd management practices to manipulate where cattle graze. The objectives of this study were to evaluate group size, strength of associations, and number of associated individuals among beef cattle within herds ranging from 27 to 240 cows.

## 2. Materials and methods

### 2.1. Study site

Data used in the study were from visual observations of cattle collected for 2 separate studies evaluating cattle distribution patterns at the Thackeray Ranch (Latitude: 48°20'N; Longitude: 109°35'W) in the foothills of the Bear's Paw Mountains in north-central Montana, USA (Bailey et al., 2001, 2006). Topographic relief in the study pastures varied from 1151 to 1398 m. Slopes varied from 0° to 48°. The average annual precipitation at the study site was 410 mm. Mean standing crop of perennial grasses on the Thackeray Ranch was 1200–1600 kg ha<sup>-1</sup> during the grazing trials (Bailey

et al., 2001, 2006). Grasses comprised 80–85% of the herbaceous vegetation. Lower elevations with gentle slopes are dominated by Kentucky bluegrass (*Poa pratensis* L.), and steep slopes are dominated by rough fescue (*Festuca scabrella* Torr.).

### 2.2. Cattle

Cattle used in the study were the result of crossbreeding experiments (Kress et al., 1996; Boss et al., 2001; VanWagoner et al., 2006) and represented varying mixtures of Angus, Charolais, Hereford, Piedmontese, Salers, and Tarentaise breeds. Cows in the study typically varied in age from 3 to 11 years in all years except in 1998, when 72, first-calf 2-yr-old heifers were also grazed on the Back pasture. Cattle were raised at the Thackeray Ranch and always grazed within the study pastures or adjoining pastures from June through December. During January through May, all cattle were moved to another location, fed hay, and managed as a single herd. Most of the cattle within the study pastures had calves during the study. Typical of many ranches in the western United States, replacement females (6 months to 2 years) were usually managed separately from the mature cows. After the breeding season following their first calf, younger cows (i.e., approximately 27 months) were combined with mature cows and managed together as one herd. The same cattle were used each year except for replacement females and cows that died or did not become pregnant and were culled. At a minimum, animals were exposed to each other within the same pasture for 6 months before observation began each year. Herd sizes (total number of cows in a pasture) ranged from 27 to 240 cows (Table 1).

### 2.3. Pastures

Pasture size varied from 78 ha to 337 ha (Table 1). Cows grazed the Rakes pasture in 1997 from early-June to mid-July and cows grazed the Back pasture in 1997 and 1998 from mid-July to early September (Table 1). In 1999, 2000, and 2001, the Back and Rakes pastures were each subdivided into 2 separate pastures (i.e., West and East) as part of a separate study where cattle were assigned to different pastures based on their previous grazing patterns (Bailey et al., 2006). Cows were ranked on observed terrain use and then classified into one of two treatments (i.e., hill climbers or bottom

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