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Changes in vigilance, grazing behaviour and spatial distribution of bighorn sheep due to cattle presence in Sheep River Provincial Park, Alberta

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ABSTRACT

The physical presence of livestock can influence the behaviour of native ungulates. Behavioural data on bite rates and vigilance of Rocky Mountain bighorn sheep were collected during the summer and fall of 2006 in Sheep River Provincial Park, Alberta. Spatial distributions of bighorn sheep and domestic cattle were recorded using daily censuses and GPS collar locations during the same time period. We hypothesized that the presence of cattle would induce a negative behavioural response in bighorn sheep and cause avoidance behaviour. As predicted, foraging bite rates decreased and vigilance rates increased when cattle were located nearby. Vigilance in females was higher than in males. The average distances between bighorn sheep and cows were found to be smaller than expected at random, and minimal distances were not affected by the presence of cows. The sheep were found in the same general areas used by cattle. The cattle presence was shown to influence distribution and behaviour of bighorn sheep, although not in the way we expected.

1. Introduction

Of all human activities, farming has the most widespread effects on terrestrial ecosystems in North America (Fleischner, 1994). Even though livestock agriculture played an invaluable role in the growth and development of our civilization, we still do not fully understand the extent of its impacts on the environment. The competition between cattle and native ungulates is a common concern (Pickford and Reid, 1943) and the effect of grazing remains highly controversial despite many studies (Chaikina and Ruckstuhl, 2006). Whereas some authors have suggested that cattle grazing benefits native ungulates (Anderson and Scheninger, 1975; Gordon, 1988; Bastian et al., 1991; Vavra and Sheehy, 1996), others have claimed that livestock grazing may reduce forage availability and lead to the decline of some ungulate populations (Dunham et al., 2003; Mishra et al., 2004).

The introduction of livestock into a new area can cause a variety of problems, such as introduction of foreign pathogens and parasites (Bengis et al., 2002), increased disease transmission (Woodroffe, 1999), decreased forage availability, and range deterioration (DeMarchi, 1973; Westenskow-Wall et al., 1994; Clark et al., 2000). Grazing by high density of cattle can alter grassland ecosystems (Fleischner, 1994) and negatively affect native ungulates (Jenks and Leslie, 2003; Mishra et al., 2004).

Livestock ranching is an important component of agriculture and, if well managed, can increase winter forage quality and range productivity, allowing for a higher economical yield of the area (Westenskow-Wall et al., 1994; Alpe et al., 1999; Clark et al., 2000; Ganskopp et al., 2006). For example, introduction of a new management plan to a range in north-eastern Oregon increased population size of both elk and livestock due to an improvement in range conditions (Anderson and Scheninger, 1975).

Most previous studies of cattle grazing have focused on the vegetation availability (DeMarchi, 1973; Alpe et al., 1999; Clark et al., 2000) and diet overlap between cattle and wildlife (Gallina, 1993; Pordomingo and Rucci, 2000; Stewart et al., 2003). However, some research also investigated changes in the behaviour of native ungulates resulting from livestock presence, such as avoidance of the areas grazed by cattle (Kie, 1996; Coe et al., 2001, 2004). Livestock grazing has been shown to affect habitat use and cause preference for ungrazed sites over grazed sites by mule deer and elk (Knowles and Campbell, 1981; Skovlin et al., 1983; Bowyer and Bleich, 1984; Loft et al., 1991; Ragotzkie and Bailey, 1991; Frisina, 1992; Clegg, 1994; Stewart et al., 2002). Livestock grazing can also cause native ungulates to change feeding behaviour or increase vigilance when cattle are in the vicinity, as previously observed in elk (Mattiello et al., 2002). On the other hand, Halstead et al. (2002) showed that cattle grazing had relatively little effect on elk choice of foraging areas. Elk and cattle had a large niche overlap, using

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similar areas and consuming similar foods (Torstenson et al., 2006). The findings of these studies indicate the need for additional research on behavioural changes of native ungulates in the presence of cattle.

In summary, cattle can affect bighorn sheep and other ungulates via direct competition for food, by using similar grazing areas and consuming similar foods. Cattle presence can also cause avoidance behaviour, as ungulates could move away from the areas occupied by cattle due to visual and audio disturbances.

The abundance of bighorn sheep in North America has decreased significantly during recent decades as a result of human influence and in part, due to cattle grazing (Krausman, 2000). The presence of livestock reduces relocation success of bighorn sheep (Singer et al., 2000). Bissonette and Steinkamp (1996) argued that bighorn sheep avoided cattle and moved towards escape terrain when cattle approached. However, very few studies of cattle grazing selected bighorn sheep as a study subject and more research is needed to conserve these animals.

In 2005, we began studying the influences of domestic cattle on behaviour of bighorn sheep, which are easily observed and well studied in the Sheep River Provincial Park, Alberta, Canada. Cattle grazing during summer was originally introduced to this area in 1917 (Alberta Community Development, 2006). The impacts of this grazing on native ungulates, such as bighorn sheep are still unknown. The sheep numbers in the park have been declining over the years, and the population is facing threats from cougar predation (Ross et al., 1997), pneumonia outbreaks (Festa-Bianchet, 1988), and hunting pressures. Forage availability may be a concern and the summer cattle grazing may also induce a response in bighorn sheep and cause changes in their behaviour. The physical presence of cattle can impact native ungulates by creating disturbance and introducing alarming visual and audible stimuli (Mattiello et al., 2002). We hypothesized that bighorn sheep will change their behaviour when cattle are present nearby and predicted that sheep would become more vigilant and graze less near livestock vs. further way. We also expected that bighorn sheep would avoid cattle. We have defined avoidance behaviour as a greater distance between sheep and cattle locations than expected from random association.

2. Methods

2.1. Study site

The study took place in the Sheep River Provincial Park at the foothills of the Rocky Mountains, south-western Alberta (50°N and 114°W). Altitudes range from 1420 m to 1740 m (Ruckstuhl and Festa-Bianchet, 2001) and the area is represented mainly by grass and shrubland communities, with some deciduous and coniferous forests. Vegetation varies from native communities dominated by rough fescue (*Festuca scabrella*) to heavily grazed areas dominated by invasive species, such as Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*) (Willoughby and Alexander, 2006). Glacial terraces, canyons, and foothills characterize the terrain of the study site. Hill slopes stay free of snow for much of the year and provide winter forage for native ungulates. Sheep River Provincial Park is home to bighorn sheep, white-tailed deer, mule deer, elk and moose (*Alces alces*). The park is accessible to public driving from May 15 to December 1.

The park is leased to cattle farmers who use a grazing-rotation system. Grazing allotments were introduced in the area in 1917 (Alberta Community Development, 2006). Currently, between the North and South Sheep allotments, approximately 3400 cow–calf pairs in 5 cattle groups use the park (18,522 ha) from mid-June until mid-October (Alberta Community Development, 2006). The park is divided into grazing allotments by fences and cattle gates. Cattle owners often rotate livestock through the park by moving them from one grazing allotment to another, using horseback riders. Cattle are introduced into different areas of the park at different times during the grazing period to distribute grazing intensity. These rotations happen only several times throughout the grazing season. For the rest of the time, livestock are not associated with humans or dogs. The observations for this study were not carried out during rotational periods or shortly after.

The population of bighorn sheep within the park has been studied extensively since 1987 (Ruckstuhl, 1998; Ruckstuhl and Festa-Bianchet, 1998, 2001) and reproductive success, age, and survival of the individuals are monitored continuously. According to the field records, the number of sheep declined from 153 in 1985 to about 60 animals in 2006. Bighorn sheep segregate sexually into male and female groups, but both sexes forage in the same areas of the park (Ruckstuhl, 1998). Female groups include females, lambs and young animals. Male and female groups merge during the fall to rut (early November to late December). Females leave the park during May to give birth in the mountains and return to the park during late August or September (Ruckstuhl and Festa-Bianchet, 1998). Some males and females leave the park during the rut to find mating opportunities elsewhere. All sheep are marked with ear tags, and some are equipped with GPS collars to monitor locations and habitat use. The animals are habituated to people and easily observable.

2.1.1. Behavioural changes

We investigated changes in vigilance and bite rates of bighorn sheep to evaluate the effect of cattle presence. Observations were collected when cattle were either present or absent. Throughout the study period, cattle traveled in the loosely cohesive groups usually made up of 10–100 individuals. Presence of cattle was defined as a group of at least 10 cattle located at a distance of less than 500 m from the sheep. The 500-m distance allowed researchers to observe both sheep and cattle at the same time without being restricted by topographical features. Absence of cattle was defined when no cattle were present in the visible and audible (to humans) range of the bighorn sheep.

Observations were made from 08:00 until 21:00 from May to September 2006. Male and female sheep of all ages present in the park were observed using binoculars (Leica 10 × 40) and a spotting scope (Bushnell Spacemaster 60 × 10–45). Because the same researchers were present during observations of sheep with cattle present or absent, the impact of researchers' presence was assumed not to influence the results. Date, time of the day, animal ID, temperature and location of the sheep were recorded. Animal ID was determined through the use of ear tag. Temperature was collected at the same time (in the mornings) each day prior to the start of observations.

We followed the methods from Ruckstuhl et al. (2003) for the vigilance and bite rates counts. Ten visual 1-min focal observations were made on vigilance and bite rates for each individual sheep during the same day as the sheep were grazing. Vigilant posture occurred when a sheep stopped grazing and raised its head above its shoulders. A bite was defined as the vegetation intake with the mouth followed by a quick upward motion of the jaw. Thus, one such movement was counted as one bite. A watch was timed to sound at 1-min intervals, and the number of bites and vigilance postures for the focal individual were recorded on a spreadsheet after each sound, for 10 separate minute intervals. Vigilance and bite rates were recorded only when an animal was feeding. The normal pattern of feeding involved grazing behaviour interrupted by short bouts (less than 30 s) when an animal lifted its head to examine its surrounding. If an individual stopped grazing for longer than 30 s during the 1-min interval the observation was discarded. The observations continued once the animal resumed