EFFECTS OF TOURIST ACTIVITIES ON UNGULATE BEHAVIOUR IN A MOUNTAIN PROTECTED AREA

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Abstract - Many protected areas seek to both preserve biodiversity and promote recreational activities. These objectives, however, may conflict if human activities reduce animal use of protected habitat. To determine if traffic volume affected the area-use pattern of wild ungulates, I conducted ungulate surveys along a road in the Sheep River Provincial Park, Alberta, over two years. I counted groups of four ungulate species, and compared the number seen during weekdays (low traffic volume) and weekends (high volume). Fewer groups of all three cervid species were seen during weekends than during weekdays, while no difference was observed for bighorn sheep. Bighorn sheep, however, flew at the sight of or when chased by domestic dogs. High traffic volume decreased ungulate use of habitat areas within sight of the road. Anthropogenic disturbance therefore led to habitat loss in this protected area because during days with heavy traffic, ungulates avoided habitat close to the road. Moreover, harassment by domestic dogs artificially increases the predation risk perceived by ungulates, which is likely to increase vigilance, decrease foraging time and cause bighorn sheep to spend more time in escape terrain.

Keywords - roads, disturbance, ungulates behaviour, protected areas

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1. Introduction

Several protected areas have been established to conserve biodiversity. Many parks, however, also encourage tourist visitation and promote outdoor recreational activities, including wildlife viewing. Unfortunately, wildlife protection and outdoor recreation may be in conflict if human visitation leads to disturbance of wildlife (Berger & Daneke, 1988; Lott & McCoy, 1995; Duchesne *et al.*, 2000). While ecotourism can produce revenue for protected areas (Duffus & Dearden, 1990; Giannecchini, 1993) an excessive number of visitors in a small area may compromise its ability to support wildlife (Boyle & Samson, 1985). Several studies have shown that anthropogenic disturbance may reduce the use of some habitats by limiting animal movement or because animal avoid areas with high human activities (such as road or trails) (Kuck *et al.*, 1985; Cassirer *et al.*, 1992; Côté, 1996; Papouchis *et al.*, 2001; Fortin & Andruskiw, 2003). In this sense, human disturbance may cause habitat loss by forcing animal to abandon suitable habitat (Gander & Ingold, 1997). As Creel *et al.* (2002) pointed out, managers of protected area must address the impacts of human activities by looking at the effects of those activities on animal behaviour and fitness.

The recent increase in wildlife watching, ecotourism and human recreation has led to greater use of parks and other protected areas (Boyle & Samson, 1985; Papouchis *et al.*, 2001) increasing the number of people traveling on access roads and trails within those areas. Roads have a major impact on wildlife by creating barriers to movement (Clevenger & Waltho, 2000; Clevenger *et al.*, 2001), limiting gene flow and increasing population fragmentation (Forman & Alexander, 1998). Several studies have shown that roads directly increase wildlife mortality through poaching (Cole *et al.*, 1997), roadkills (Bruinderink & Hazebroek, 1996; Cain *et al.*, 2003) and increased accessibility for hunting (Peres & Lake, 2003). While many studies have examined the impact of roads on poaching, habitat fragmentation and traffic accidents, fewer studies have quantified the effects of traffic volume on ungulate behaviour in protected areas. The noise caused by motorized traffic can disturb animals (Clevenger *et al.*, 2001), especially if access is unrestricted (Cole *et al.*, 1997). The creation of new roads also increases the accessibility of remote areas to hikers or hunters (Peres & Lake, 2003). People enjoy photographing wildlife and taking their dogs for walks in natural areas, but when those human activities become

frequent they may have short and long-term consequence on animal populations (Boyle & Samson, 1985). Dogs can be perceived as potential predators by ungulates (Manor & Saltz, 2004). Therefore, disturbance caused by hikers or dogs will increase time spent vigilant, decrease foraging time (Childress & Lung, 2003; Hunter & Skinner, 1998) and increase stress in wild animals (MacArthur *et al.*, 1979). Moreover, when anthropogenic disturbances cause the animal to run, they increase daily energy expenditure (Cassirer *et al.*, 1992; Tyler, 1991). If the disturbance persists over the long-term it may affect reproductive success and recruitment (Kerley *et al.*, 2002). In the absence of unequivocal data demonstrating an impact of human activities, however, managers are often reluctant to accept that non-consumptive outdoor recreational activites may lower the carrying capacity of protected areas (Gander & Ingold, 1997; Papouchis *et al.*, 2001).

Here I examine if the level of traffic through a protected area affects the area-use patterns of ungulates. I conducted road transects during weekdays (low traffic) and weekends (dense traffic), and compared the number of ungulates groups seen in areas within sight of the road. I also compared the reactions of bighorn sheep, *Ovis canadensis*, to domestic dogs and to natural predators such as coyotes, *Canis latrans*, and cougars, *Puma concolor*, to assess whether dogs were recognized by sheep as a potential threat.

2. Materials and methods

2.1. Study area

The Sheep River Provincial Park in southern Alberta (50°40'N, 114°35'W, elevation 1450-1700m) was created in 1971 as a wildlife sanctuary to protect bighorn sheep and mule deer, *Odocoileus hemionus*, wintering habitat. In 2001, the sanctuary was declared a Provincial Park. It is traversed by a paved road from east to west, along the valley bottom. On this scenic road, tourists can see several species of wild animals from their vehicles. Wildlife viewing and other recreational activities attract many visitors. Traffic through the park increased over the last decade (Fig. 1). The Sheep River Provincial Park is less than one hour's drive from Calgary, a fast-growing metropolitan area of over one million inhabitants. Camping, hunting and trapping are not permitted in the Park, but wildlife viewing is encouraged. Dogs are supposed to be kept at a leash but this rule is rarely enforced. The road is closed to motorized traffic from December 1 to May 15 each year. The park is characterized by many open grassy slopes and cliffs where ungulates can be easily seen from the highway. The ungulate species are white-tailed deer, *Odocoileus virgianus*, elk, *Cervus elaphus*, moose, *Alces alces*, mule deer and bighorn sheep. The main predators observed in the area are cougars and coyotes. Cougars prey on all sex-age classes of sheep (Ross *et al.*, 1997) while coyotes mostly prey upon lambs (Hass, 1989). Black bears *Ursus americanus*, grizzly bears, *U. arctos* and wolves, *Canis lupus*, are also present, but they have not been documented to prey on bighorn sheep in this area.

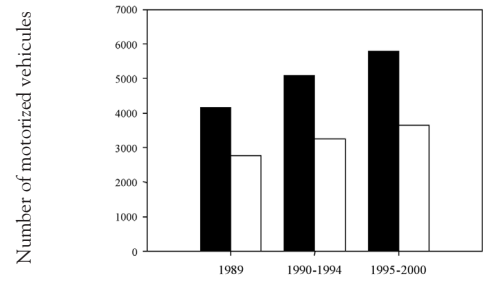

Fig. 1 Motorized vehicles using the road traversing the Sheep River Provincial Park, Alberta, Canada, during summer and autumn from 1989 to 2000. Black bars represents the average in July and August and white bars are average numbers in September and October. Source: Alberta Community Development, Parks and Protected Areas Division.

2.2. Road transect and car counts

To determine the effects of motorized traffic on the probability of sighting groups of ungulates from the road, I conducted 78 road surveys in the central section of the Park during 2001 and 2002 (respectively n=41 and n=37). Transects were 7 km long and were done one hour before sunset from mid-September to mid-November. I recorded all groups of ungulates seen, noting the species and location. Fridays were considered part of the weekend because many visitors arrived on Friday afternoon. To assess differences in traffic volume between weekdays and weekends, in autumn 2002, I counted the number of vehicles for weekdays and weekends during one hour samples in 26 occasions for a total of 13 hours of counts during weekdays and 13 hours during weekends. The monthly total number of motorized vehicles was measu-

red by a traffic counter at the entrance of the Park from 1989 to 2000.

2.3. Behaviour toward predators

Bighorn sheep wintering in the Park have been marked and monitored since 1981 (Festa-Bianchet, 1986). Beginning in 2000, my assistants and I recorded all observations of encounters with potential predators and with dogs. For each encounter, I noted the date, the time and the species of predator. I estimated the shortest distance (in meters) over which bighorn sheep were displaced using topographic maps. Each time an encounter between sheep and a predator occurred, the initial location of the sheep was noted. After the encounter the sheep group was relocated and its location noted. The flight distance corresponds to the shortest distance in meters between the two locations. Sheep were assumed to be displaced when they either walked or ran away from a wild predator or a dog that they had obviously sighted.

I used chi-squared tests to compare the number of ungulate groups seen per transect during weekdays and weekends. Flight distances following encounters with different predators were compared using Mann-Whitney U tests. All tests were two-tailed and were considered significant if $p<0.05$.

3. Results

During 78 road surveys (2000 n= 41 and 2001 n= 37), I saw three times more cervid groups on weekdays than on weekends (Fig. 2), including elk (n=14 groups on weekdays compared to n=3 during weekends, $X^2 = 3.84$, $df=1$, $p=0.05$), white-tailed (n=31 on weekdays and n=9 on weekend, $X^2= 5.68$, $df=1$, $p<0.02$) and mule deer (2000: n=16 on weekdays compared to n=3, $X^2 =5.0$, $df=1$, $p<0.05$). For bighorn sheep, however, there was no difference in the number of sightings during the week and the weekend (n= 81 during weekday compared to n=51 during weekends, $X^2=0.32$, $df=1$, $p>0.05$). Group size ranged from one animal to 33 for cervids and from one to 73 for bighorn sheep. Traffic volume was much higher on weekends than on weekdays with an average of 3 cars / hour during the week compared to 21 cars / hour on weekends.

Bighorn sheep tended to move farther away from dogs (sample mean =115 m, n= 13, $s.e.$= ± 24.8) than from coyotes (mean =77 m, n= 21, $s.e.$= ± 20.4; Mann-Whitney U = 92, p=0.12) and appeared to be most fearful of cougars (mean =3800 m, n=5, $s.e.$= ± 1347.2; comparison with dogs: Mann-Whitney U = 0, $p < 0.0012$). Sheep reacted to free-ranging dogs and to dogs under the control of their owners in similar ways (average escape distances was 108.3 m, $s.e.$= ± 30.46 for 9 dogs under control and 130.0 m, $s.e.$= ± 48.13 for 4 free-ranging dogs; Mann-Whitney U = 14, p=0.54). Their reaction toward coyotes was more variable, they usually walked (11 cases) or ran away (6 cases), but sometimes they watched (3 cases) or chased the coyote (1 case).

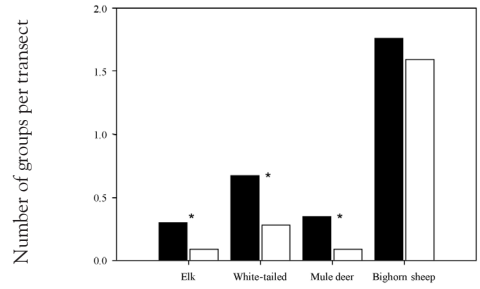

Fig. 2 Sightings of four ungulate species in the Sheep River Provincial Park during road transects during weekdays (black bars, n= 46 transects) and weekends (white bars, n= 32 transects) from mid-September to mid-November in 2001 and 2002. '*' indicates a significant difference (X^2 test, $p < 0.05$).

4. Discussion

Motorized traffic appeared to have a negative effect on the behaviour of the three deer species studied. Deer were forced to use alternative habitat when areas visible from the road were disturbed by high traffic volume and human activities, decreasing their probability of occurrence during weekends compared to weekdays. Bighorn sheep did not appear to be as affected by motorized traffic as cervids in their area-use patterns, possibly because very few areas used by bighorn sheep in the Park are out of sight of the road. To escape from perceived threats, bighorns run to cliffs and steep areas that are easily seen from the road, while deer tend to run into forested areas where they are hidden from view.

Roads cause habitat loss or degradation both directly through habitat destruction and indirectly by increasing disturbance through noise and traffic volume (Clevenger *et al.*, 2001;

Gibeau *et al.*, 2002), risk of poaching (Cole *et al.*, 1997), hiking or wildlife viewing (Lott & McCoy, 1995; Duchesne *et al.*, 2000) and stress from harassment by domestic dogs or sighting of vehicular traffic (MacArthur *et al.*, 1979). If the goal of protected areas is to conserve biodiversity, human disturbance should be avoided in habitats that animals depend on for their reproduction and survival. Because road creation in those areas will increase anthropogenic disturbance, it will likely lead to habitat degradation by forcing animals into alternative habitat (Papouchis *et al.*, 2001; Fortin & Andruskiw, 2003). In cases where roads in parks are unavoidable, the effects of roads could be minimized by limiting the number of vehicles allowed per day, avoiding new road construction within sight of critical wildlife habitat or closing roads during critical periods. On a local scale, it is important to determine which potential road placements are less likely to result in animal disturbance.

Bighorns are the species most likely to be seen by tourists at Sheep River and are also likely to be disturbed by photographers or chased by dogs. We recorded 13 encounters involving sheep and dogs over 6 months of behavioral observations. In all cases, people went hiking with their dogs in the sheep range and tried to approach sheep groups (often to take pictures) accompanied by their dogs. Sheep ran away at the sight of the dog. My observations suggest that domestic dogs are perceived as a threat by bighorn sheep which appear not to distinguish them from wild canids: sheep tend to run for longer distance at the sighting of a dog compared to coyotes. Because in most of the encounters between sheep and dogs, dogs were under control, it appears that keeping dogs at a leash will not substantially reduce their impact on sheep behavior since there was no difference in sheep behavioural reaction toward unleashed dogs (n=4) compared to dogs under control (n=9). MacArthur *et al.* (1979) reported that free-ranging canids evoked the maximal increase in heart rate for bighorn ewes. Therefore, allowing domestic dogs in a protected area, even if they are under control, may have the same effect as an artificial increase in the number of predators, which may cause a substantial energetic cost (MacArthur *et al.*, 1979). It has been shown that an increase in predator sightings decreases foraging efficiency and increases time spent vigilant in ungulates (Berger *et al.*, 2003; Childress & Lung 2003; Hunter & Skinner 1998). A decrease in foraging time coupled with an increase in daily energy expenditure following anthropogenic disturbance (Tyler, 1991) may lower the energy available for reproduction, leading to lower recruitment (Kerley *et al.*, 2002) and ultimately impaired fitness of animals. Moreover, a perception of high predation risk could lead to habitat abandonment by prey species.

In the future, we will face to a worldwide increase in human population and therefore, anthropogenic disturbance will inevitably increase. More studies addressing the impact of human activities on behaviour and fitness of animals are needed. Managers and scientists will have to work together to increase public awareness of the effects of human activities on animal disturbance and act to minimize those effects

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