

Wolf, *Canis lupus*, Avoidance Behaviour of American Elk, *Cervus elaphus*, in Jasper National Park, Alberta

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An American Elk calf (*Cervus elaphus*) that was captured near human habitation in Jasper National Park, Alberta, was fitted with a radio-collar and released 40 km away in the park's main valley of the Athabasca River. The calf joined a local herd of elk, and its radio signal revealed that the elk, in two months' time, travelled eight times back and forth between the herd's traditional semi-open winter range at Devona and a largely wooded area at Rocky River >3 km away. Each time, on their trans-valley route the elk crossed a busy highway, a railway, and a partly frozen river. Sightings of elk and Wolves (*Canis lupus*) were inversely correlated on 97 days of observation at Devona. We conclude that the elk's migrations were prompted by their urge to avoid and flee from Wolves, which were common at both locations.

Key Words: American Elk, *Cervus elaphus*, Wolves, *Canis lupus*, interactions, Jasper National Park, Alberta, Canada.

Predation has been the subject of numerous studies in a variety of taxa with the principal objective of determining what predators kill. However, more recent research has focussed on the indirect effect of predation, which is believed to have an impact on prey behaviour, mediated by fear, that may be more important than the number of prey killed (Brown and Kotler 2007). For instance, migrating shorebirds were found to avoid feeding sites near vegetation behind which hunting falcons could conceal their approach and take the prey by surprise (Dekker 1998a; Ydenberg et al. 2004). For birds, the trade-off is that safety usually comes at the cost of a lower food intake and an increase in energy expenditure (Lima and Dill 1990). Similarly, predation by large carnivores is considered a major determinant in the demographics of ungulate populations (Mech and Peterson 2003), but avoiding predation was found to be costly in terms of reproductive physiology as well as demographics (Creel et al. 2007). In Yellowstone National Park, after Wolves (*Canis lupus*) were reintroduced, American Elk (*Cervus elaphus*) retreated into woodlands, which may be safer but poorer in forage (Mao et al. 2005). In Canadian National Parks, where Wolves occur and hunting is not permitted, elk become habituated to humans and – as an anti-predator strategy – gravitate towards buildings and roads. In Jasper National Park (JNP), 50–60% of the summer population and 80% of the winter population of elk are concentrated near the Jasper town site and along major roads, presumably because large carnivores are less common than in the backcountry (Dekker et al. 1995). As a result, forage plants in these heavily utilized zones become overgrazed and damaged. In addition, aggressive elk cause problems near the town.

With the objective of preventing human/elk conflict and reducing grazing pressure, JNP staff began a program of capturing elk near the town and tourist facilities to relocate them elsewhere, either within or outside JNP. This management method proved only partially successful, because most adult elk eventually returned to the site of capture. On 31 January 2000, hoping for better results with young animals, JNP staff trapped an additional 11 elk, of which 10 were calves. To monitor their wanderings, one of the female calves was equipped with a loose-fitting neck collar and a Lotek VHF radio-transmitter. The calf was set free at Rocky River, 40 km northeast of the original capture site. In this note, we report on the results.

Study Area and Methods

JNP is 10 880 km² in size and situated in west-central Alberta between latitude 52°29' and 52°08'. Elevations range from 3747 m in the west to 990 m in the east. For a complete inventory of ecotones, flora, and fauna of JNP, see Soper (1970) and Holroyd and VanTighem (1983).

The study site is located in the lower valley of the Athabasca River, between two of its major tributaries: the Rocky River, flowing in from the east, and the Snake Indian River entering from the northwest. The valley bottomlands on the west side of the river are called the Devona Flats. Roughly 3–4 km wide, they are characterized by a mosaic of semi-open montane meadows and mixed woods of conifers, willow (*Salix* spp), and Trembling Aspen (*Populus tremuloides*). The Devona Flats are the traditional wintering range of the Devona elk herd, consisting of cows, calves, and yearlings of both sexes. Based on records obtained over 20 consecutive winters in 1981–2001, the mean size of

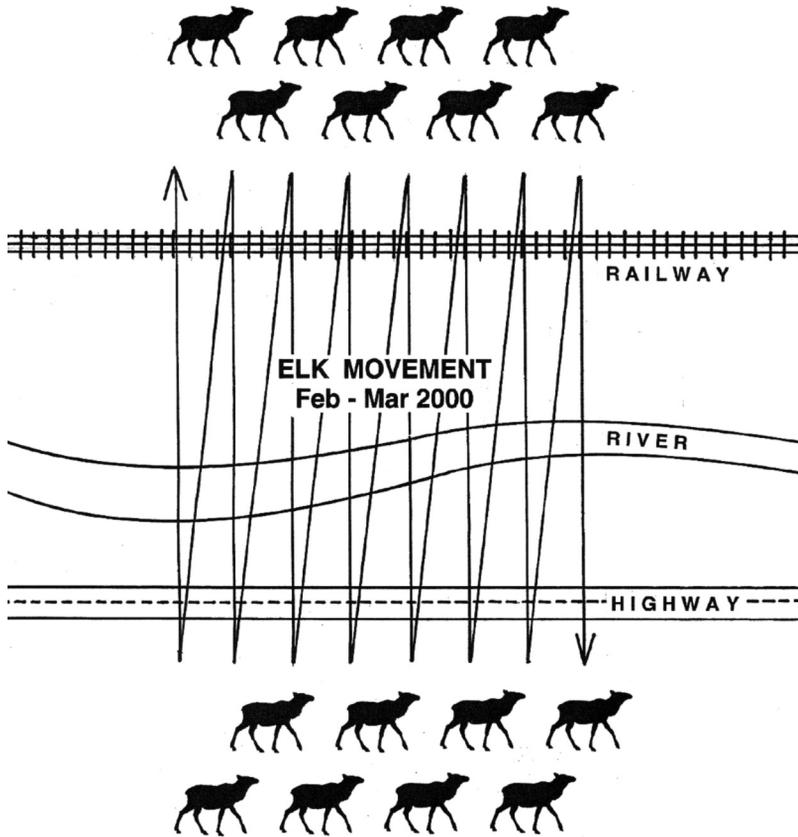


FIGURE 1. The signals of a radio-collared elk calf travelling with the Devona elk herd indicated that they switched back and forth between Devona and the valley of the Rocky River eight times during February and March 2000. The one-way distance was >3 km and involved crossing a railway, the Athabasca River, and the busy Yellowhead Highway.

the Devona cow/calf herd was calculated at 49, and the mean number of mature bulls at 16 (Dekker 2006*).

Between October and March, 2000-2009, DD visited the Devona elk winter range 36 times. Each visit included 1-3 overnights and the total number of observation days was 116. Near sunrise and sundown, he ascended a hillside vantage point and spent one hour or more scanning the semi-open meadows and river flats through binoculars. During the day, he traversed the study area on foot. Elk and Wolf presence were determined by sightings and tracks (Dekker 1998b, 2002).

The Athabasca Valley is the main traffic corridor for the Canadian National Railway and the busy transcontinental Yellowhead Highway (ca 4000 vehicles/day). In 2000-2008, the annual mean of ungulate casualties on the highway was 107 ($r = 94-127$). Ungulate casualties on the railway ranged from 37 to 62 per annum with a mean of 52.

On the day of capture, 31 January 2000, the collared elk calf was released on the east side of the Yel-

lowhead Highway just above the confluence of the Rocky River with the outlet of Jasper Lake, which is a shallow widening of the Athabasca River. To monitor its subsequent migrations, one of us (GS) determined the calf's location by the signals received through a hand-held antenna (Communication Specialists Inc.).

Results and Discussion

Within days of its release, the collared calf joined the Devona elk herd and stayed with that herd until the calf became a traffic casualty on the highway. Its radio signal was picked up 124 times. Between 1 February and 31 March 2000, its location switched between the Devona Flats on the west side of the valley to the lower Rocky River east of the highway, a distance of >3 km. Traveling between these two opposite points, the elk had to cross the railroad and the Yellowhead Highway, as well as the Athabasca River. The river crossing traditionally took place at the outlet of Jasper Lake, a circa 80 m wide channel of swift water that

stays open most of the winter. During February and March 2000, the tagged elk calf and its herd travelled back and forth eight times between the Devona Flats and Rocky River, on average 3.9 days apart (1). During these same two months, DD visually checked the Devona winter range on 11 dates. On three days, the elk herd, including the collared calf, was present on the Flats, and no recent sign of Wolves was found. By contrast elk were absent on six days when Wolves or their fresh tracks were recorded. On two days neither Wolves nor elk were seen.

During the winters of 2001-2009, DD spent all or part of 116 days on the Devona Flats. On 61 days, Wolves were seen, heard, or tracked, and the Devona cow/calf elk herd was absent. By contrast, the herd was seen on 36 days when no wolf sign was found along the pack's habitual travel routes. The presence of Wolves and elk was inversely correlated with a highly significant degree of probability ($P < 0.000001$). On 12 days, or part thereof, both Wolves and elk were in the area; on the remaining 7 days snow cover was insufficient for tracking and neither elk nor Wolves were seen (Table 1).

We believe that the reason for the trans-valley migrations of the elk was Wolf avoidance. In the winter of 1999-2000, the Devona Flats were part of the territory of a pack of 8-11 Wolves. In other years, there was a second pack of 2-4 Wolves (Dekker 1998b, 2002).

Although we never observed Wolves in the act of making a kill, we saw them pursue elk that fled into the woods. Some hard-pressed elk made a stand in turbulent rivers or on steep ground. Similar defensive tactics of elk were recorded by other observers in JNP or in adjacent Alberta forests (Cowan 1947; Van Tighem et al. 1980; Kansas 1981; Schmidt and Gunson 1985). Remains of elk evidently preyed upon by Wolves were occasionally found in the woods or on frozen water courses. As determined by fresh tracks, some elk chased by Wolves broke through river ice and drowned. Others became casualties on the railway and highway. Elk (and deer) chased by Wolves appeared oblivious to other dangers and ignored people (Dekker 1997; and unpublished data).

During the winters of 2000-2009, the Devona Wolf pack travelled back and forth between Devona and Rocky River roughly along the same route as the elk herd. As reported by wardens and members of the public, packs of Wolves were occasionally seen crossing the Yellowhead highway in either direction. The Devona pack, as identified by numeric and pelage characteristics, was photographed at Rocky River by Brian Genreux (wildlife photographer). Travelling between Devona and Rocky River, the Wolves either crossed frozen Jasper Lake or swam the open outlet. In some years, there were two different Wolf packs on opposite sides of the Athabasca River.

In conclusion, our findings suggest that the Devona elk herd and its radio-tagged calf departed their traditional wintering range to avoid Wolves. The reason

TABLE 1. Presence of American Elk and/or Wolves on the Devona elk winter range in Jasper National Park, Alberta, during the winters of 2000-2009.

	Observation days
Wolves in area but no elk herd	61
Elk herd in area but no Wolves	36
Both Wolves and elk present	12
Neither Wolves nor elk in area	7
Total observation days	116

why the elk herd kept returning to the Devona Flats, after having been chased out of there, can be explained by: (1) the superior grazing on the montane meadows compared to the mostly wooded terrain on the other side of the valley; (2) the tendency of elk to seek out Devona's open terrain because approaching predators can be spotted early; and (3) the elk were chased back to Devona and away from Rocky River by Wolves.

Changes in elk habitat preference, purportedly to avoid Wolves, were also reported from Yellowstone National Park and Montana (Mayo et al. 2005; Ripple and Beschta 2003; Creel et al. 2005). However, while noting that elk prefer open range because of better grazing, Winnie and Creel (2006) thought that open country was dangerous for elk because more Wolf kills were found in the open than in the woods, although the researchers were puzzled by their observation that the elk showed less vigilance in the open. In our view, a lower level of vigilance should be expected on open terrain because of better visibility. A parallel situation involves shorebirds that favour mudflats away from obstructive vegetation so as to avoid surprise attacks by falcons (Dekker 1998a, Dekker and Ydenberg 2004). At Devona, the local elk herd was extremely shy of people and easily spooked by humans as well as Wolves. This is in marked contrast to the behaviour of human-habituated elk that remain near the Jasper town site and along major roadways, where grazing opportunities as well as visibility have been enhanced by tree clearing.

A very different antipredator strategy of the Devona elk comes into play during spring and early summer. Then, pregnant cows shun open terrain and hide on densely forested islands in the lower Athabasca River. Nevertheless, predation on the young appears to be heavy. As determined by a large sample of early winter counts, the cow/calf ratio of the Devona herd is 100/19 as compared to 100/48 for elk that remain all year near the Jasper town site and along major roadways (Dekker et al. 1995).

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