UNGULATE ENCOUNTERS WITH CONSTRUCTION MATERIALS (PIPE, BERMS, ETC.) DURING THE BUILDING OF AN UNDERGROUND GAS PIPELINE IN WESTERN ALBERTA, CANADA.

Luigi E. Morgantini
Wildlife Resources Consulting Ltd.
P.O. Box 652, Sub. 11, U of A,
Edmonton, Alberta, Canada T6G 2E0.

Abstract: This study monitored the response of moose (Alces alces), elk (Cervus elaphus) and deer (Odocoileous hemionus and O. virginianus) to the presence of pipe and berms during the construction of a 106 cm underground gas pipeline in western Alberta, Canada. Pipe, either lying on the ground or welded and lying on skids, acted as a visual and physical barrier to the free movement of animals. Elk and deer were affected by pipes on the ground, while moose jumped over them. Welded pipe, lying on skids, with an average pipe-to-ground clearance of 98 cm, did not limit deer movements, but impeded moose crossings. The presence of pipe on the pipeline right-of-way did not appear to alarm ungulates. Due to the presence of openings, dirt berms did not appear to act as a barrier. Moose, elk and deer crossed at breaks profile openings and at gaps associated with the roughness of berms.

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Studies on the impact of pipelines on wild ungulates are largely restricted to the response of caribou (Rangifer tarandus) and moose to the Trans-Alaska Oil Pipeline (Child 1973; Cameron and Whitten 1976, 1977, 1978; Van Ballenberghe 1978). However, most of the data relates to elevated pipelines and has been collected during post-construction studies. Little is known of the impact of actual pipeline construction on ungulates.

During the winter of 1980-81, Nova, An Alberta Corporation, planned to twin its existing underground gas pipeline in western-central Alberta, by widening the right-of-way and adding a second 106-cm pipeline. The pipeline corridor traverses several wildlife wintering ranges. Due to the concern about the environmental impact of construction activity, Nova commissioned a wildlife monitoring program to assess the impact of pipeline construction on wild ungulates.

The data presented in this paper summarize the response of moose, elk and deer when encountering pipe and berms along the right-of-way.

STUDY AREA

The study was conducted along the Nova pipeline corridor that extends from the Brazeau River (LSD-5, SEC-27, TP-44, R-13, W5W) to the Ocelot Road (SE, SEC-36, TP-52, R-18, W5W), 45 km south of the city of Edson. The corridor is located within the Lower Foothills Section of the Boreal Forest Region (Rowe 1972). The area is characterized by the presence of extensive muskeg plateaus, interspersed with low hills and ridges. Elevation ranges from 975 to 1,220 m. The vegetation varies with soil drainage and moisture. Dense stands of black spruce (Picea mariana) are common in poorly drained sites. Pockets of tamarack (Larix laricina) occur in more wet and open sites. In older forests and moderately drained areas, white spruce (Picea glauca) is frequent. On well drained sites white spruce is replaced by balsam poplar (Populus balsamifera), aspen (Populus tremuloides) and lodgepole pine (Pinus contorta). Alder (Alnus spp.), willow (Salix spp.) and birch (Betula spp.) are the dominant shrub species. Grassy alluvial meadows and willow flats are found along creek and river valleys.

The region supports widely dispersed populations of moose, elk and deer. Information on their number and distribution is limited. In December 1979, the calculated densities per linear mile, over 261 linear survey-miles, were 0.54 moose, 0.53 elk and 0.06 deer (Olson and Smith 1979, Alberta Fish and Wildlife Div. Edson. unpub. rep.).

METHODS

This study was initiated on December 1, 1980 and completed on March 31, 1981.

Pipeline construction in the study area began on December 1, 1980. At the time the existing corridor had already been cleared and widened. Pipeline construction activities consisted of different phases. Initially, pipe joints, 22 m

long and 106 cm diameter, were laid on the ground and strung out along the corridor. Subsequently pipe joints were raised on blocks, 80-180 cm above the ground, and welded. Trenching, laying pipe in and backfilling followed closely behind. The linear distance between the leadpoint of construction phases varried from 1 to 25 km. Pipeline construction in the study area was completed by January 31, 1981. However, extensive dirt berms remained along the corridor until March 31, 1981.

From December 11, 1980, to January 11, 1981, construction activities were shut down. This month long work stoppage was partially instrumental in collecting data, since it offset a possible wildlife avoidance of the corridor due to construction activities.

In order to detect movements of animals across the pipeline right-of-way, and to determine their response to the presence of pipe and/or dirt berms, permanent transects were established along 54 km of the right-of-way. Transects were 500 m long and spaced every 750 m. Attempts were made to survey transects once a week. However, in late winter, due to a lack of snow on the right-of-way, several surveys had to be postponed until two days after snowfall. Transects were surveyed on foot. Whenever possible, additional data were collected from portions of the right-of-way between the transects. In the event of a direct sighting, the observation was tabulated only if the animals were not aware of the observer presence.

Wildlife tracks crossing or approaching the pipeline right-of-way were followed for a distance sufficient to identify the activity of the animals and their response to the presence of pipeline construction artifacts. Only observations that clearly indicated approach to the pipeline right-of-way with the intent to cross it were considered "crossing attempts". Crossing of the pipeline right-of-way was considered successful if the animals were able to move across pipe and/or berms. Groups were considered social units, regardless of their sizes. Hence, comparison of successful and unsuccessful crossings were made on a group basis.

RESULTS AND DISCUSSION

With the advance of construction in December 1980 and January 1981, pipe was either strung and lying on the ground or welded and set on blocks, 80-180 cm above the ground. In this period, a total of 76 groups of ungulates were identified as attempting to cross the pipeline right-of-way (Table 1).

Table 1. Pipeline crossing attempts by ungulates when strung or welded pipe was present. December 1980-January 1981.

Species	Total no. of animals	No. of groups	% of groups crossing right-of-way	% of groups reversing movements
Moose	45	32	41	59
Elk	40	23	52	48
Deer	30	21	48	52

Table 2. Attempts by ungulates to cross pipeline right-of-way when strung pipe was present. December 1980-January 1981.

		Successful crossing attempts			Unsuccessful crossing attempts			
	no. of groups	% of groups	jump pipe	through break	% of groups	After following r/w 1-25m	26-100m	100m+
Moose	16 (21)	50.0	4	4	50.0	1	5	2
Elk	17 (32)	52.9	1	8	47.1	2	2	4
Deer	13 (22)	38.5	0	5	61.5	5	2	1

( ) Total number of animals involved.

Table 3. Attempts by ungulates to cross pipeline right-of-way when welded pipe was present. December 1980-January 1981.

		Successful crossing attempts				Unsuccessful crossing attempts			
			under pipe clearance(cm)				After following r/w		
	no. of groups	% of groups	$\bar{x}$	sd	n	% of groups	1-25m	26-100m	100m+
Moose	16 (24)	31.2	164	10	4	68.8	4	4*	3
Elk	6 (8)	50.0	120	12	3	50.0	2	0	1**
Deer	8 (8)	62.5	91	6	5	37.5	0	1***	0

( ) Total number of animals involved.
* made 6 attempts to cross
** 5 animals walked for 550 m.
*** made 2 attempts to cross

Of these, 41 groups (53.9%) failed to negotiate pipe and reversed their movements. Crossing success did not differ significantly among species (G=.819, d.f.= 2). However, elk appeared to be the most successful (52%), whereas moose appeared to be the least successful (41%).

Pipeline-ungulate interactions are further classified in Tables 2 and 3 on the basis of whether they involved strung or welded pipe. While there was no difference in the percentage of elk successfully crossing strung or welded pipe sections, the response of moose and deer to the two types of obstruction was quite different. The percentage of successful crossings by moose dropped from 50% in the sections with pipe strings, to 31.2% when pipe was welded and set on blocks. Conversely, deer success rate increased from 38.5% to 62%. The relatively small sample size limits meaningful statistical comparisons. Nonetheless, a species-specific differential response is apparent. It may indicate that the presence of an obstacle which impedes line of sight is more important than its actual size. A 106-cm diameter pipe, lying on the ground, would likely act as a visual barrier for a deer (shoulder height: 97-107 cm. Banfield 1977), regardless of the animal's physical ability in jumping obstacles. A deer, however, can easily see across and walk under welded pipe set on blocks, for instance, 100 cm above the ground. On the other hand, a moose (shoulder height: 152-192 cm. Banfield 1977) may find the latter a bigger obstacle unless it is sufficiently high above the ground. Hanson (1981) reported that berms higher than 120 cm deflected movements of barren-ground caribou (shoulder height: 99-112 cm. Banfield 1977) even though they were easily able to walk on top of them.

During this study, ungulates moved across the right-of-way by jumping strung pipe, by passing under pipe set on blocks, or by walking to an opening. Animals crossed whenever openings in pipe stringing were encountered. Initially, openings in pipe strings occurred only, on an average, every 380 m. In January, however, openings 2 m wide were left every 6 pipes (approx. 130 m). The response to strung pipe lying on the ground varied between species. Elk were the most successful in crossing at openings and the most "persistent" in searching for them (Figure 1). In general, moose, and to a greater extent deer, tended to follow the right-of-way for shorter distances (Figure 2). With the exception of a single elk, moose were the only species observed jumping strung pipe.

Passing under welded pipe was more common. Pipe-to-ground clearance heights varried from 60 to 180 cm. Average clearances used by moose, elk and deer (Table 3) tend to reflect species-specific average body size. Crossings by deer occurred at clearances between 82 and 100 cm, by elk between 105 and 135 cm, and by moose between 150 and 175 cm. The small sample size does not allow a statistical assessment of ungulate response to different pipe-to-ground clearances. In three cases where deer reversed their movements, clearances were 80, 95 and 98 cm, well within the range of

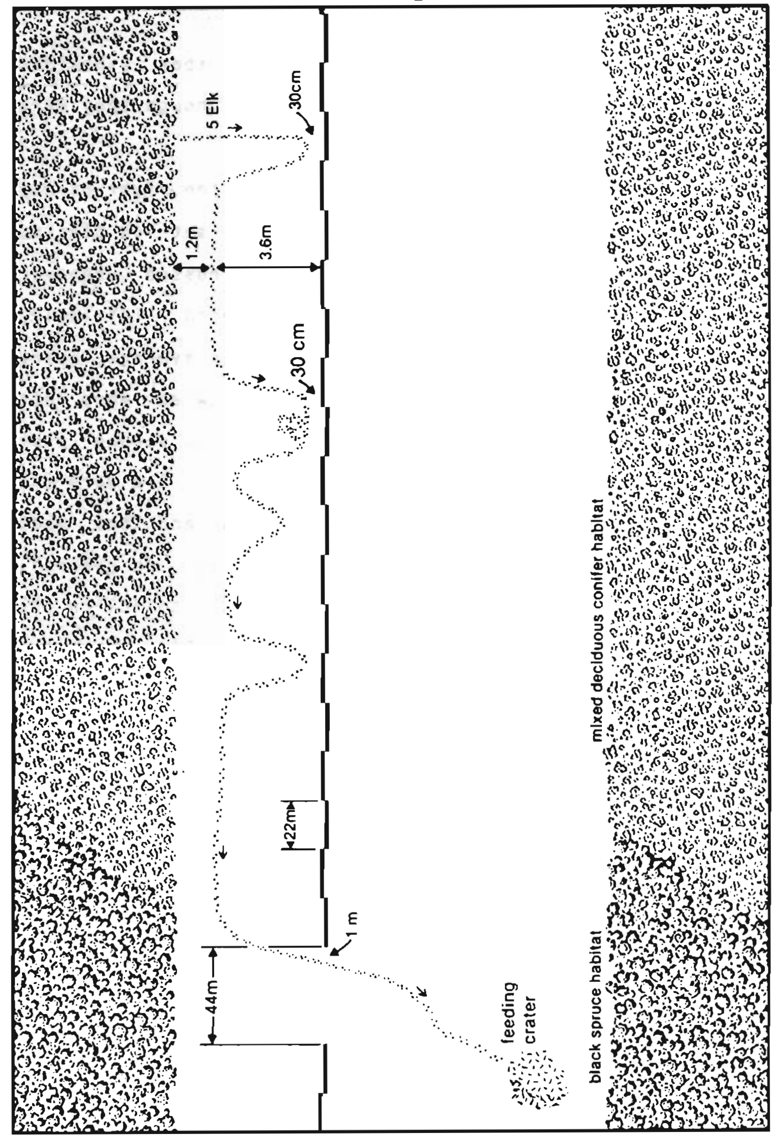

FIG. 1 BEHAVIORAL RESPONSE OF 5 ELK WHEN ENCOUNTERING STRUNG PIPE ON THE PIPELINE CORRIDOR.

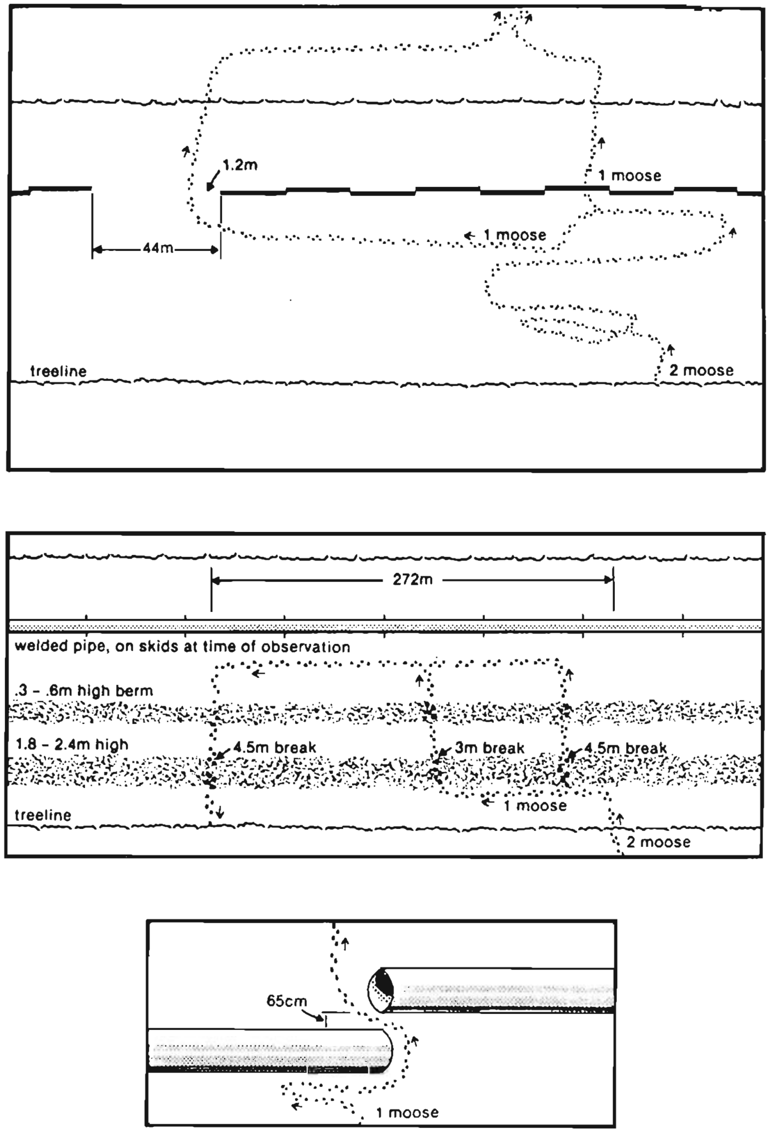

FIG. 2 THREE INSTANCES OF MOOSE ENCOUNTERS WITH STRUNG AND WELDED PIPE ON THE PIPELINE CORRIDOR.

clearance heights for successful crossing. Similarly, in one instance one elk followed the right-of-way for more than 500 m, and failed to cross despite the presence of several sites where pipe clearance was well above 120 cm. It appears that individual behavioral responses to the presence of an unfamiliar object can play an important role in determining crossing success.

Moose failed to cross the welded pipeline in 11 instances (68.8% of the observations). The average pipe-to-ground clearance was 98 cm (± 8 sd) with a range of 90-110 cm. Successful crossings occurred where pipe was elevated an average of 164 cm (± 10 cm) above the ground. These results are consistent with the study conducted by Van Ballenberghe (1978) on moose encounters with the Trans-Alaska Pipeline. The author reported that 87% of crossings at pipe-to-ground clearances below 180 cm, occurred within a 150-180 cm range. Pipe elevations of less than 120 cm above the ground were thought to physically impede moose from crossing.

Dirt berms were generally associated with clearing, grading, trenching and backfilling. Their height ranged between 30 and 210 cm. Gaps in the profile of berms as wildlife paths were made by either moving debris aside or simply by driving a crawler tractor directly across the top of the berm. Due to mild winter conditions, and minimal late-winter snowfall, significant snow berms were never observed.

Lack of snow on the right-of-way in February and March made the identification of signs difficult, and many tracks may have been missed. Nonetheless, a summary of wild ungulate encounters with dirt berms is presented in Table 4.

Table 4. Crossings of dirt berms by groups of ungulates. February-March, 1981.

Dirt berm height	< 122 cm		123-182 cm		> 182 cm	
Success	yes	no	yes	no	yes	no
Elk	1(6)a	0	18(53)*	4(6)*	0	0
Moose	4(5)	0	8(10)	0	4(5)**	1(1)
Deer	3(10)	0	3(12)	0	0	0

a( ) No. of animals.
* 13 successful and 3 unsuccessful attempts were observed over a 1.5 km interval, during a single survey.
** Average width of opening: 4.8 m.

A comparison between the species cannot be carried out since, for instance, elk and deer were never observed along portions of the right-of-way with high dirt berms. The data collected indicate that dirt berms did not constitute a barrier to animal movements, when either openings or gaps in their profile were present. For a successful crossing, visibility across the berm appeared to be very important. In most cases, animals selected sites where an opening was present or where the berm was lowest. A similar behavior has been described in barren-ground caribou (Cameron and Whitten

1976). There were instances, however, when animals responded to the presence of construction vehicles driving along the right-of-way by flight, which involved crossing the dirt berm at its closest point, regardless of its height.

CONCLUSIONS

This study was carried out during the typical construction of a large diameter underground gas pipeline in Alberta. The fast progress of pipe stringing, welding, trenching, laying-in and backfilling limited data acquisition. The few encounters between wild ungulates and pipeline construction artifacts may also reflect some avoidance by wildlife of the pipeline corridor during construction. Despite a relatively small sample size, this study clearly shows that berms and large diameter pipe, either lying on the ground or welded and set on blocks, may act as a visual and physical barrier to the free movement of moose, elk and deer. The presence of pipe and berms, however, apparently do not alarm them, as indicated by their extensive use of the right-of-way. Hence, the presence of openings can effectively mitigate this type of pipeline construction impact.

Partially as a result of this study, Nova, An Alberta Corporation is allowing for openings and breaks to be left in wildlife sensitive areas during the construction of large diameter underground pipelines.

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