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INDUSTRIAL DEVELOPMENT ON PRIME BIGHORN SHEEP RANGE IN SOUTH-WEST ALBERTA

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Abstract: During 1987-1989, Shell Canada Limited completed construction of a new road and the drilling of 2 gas wells on a mountain ridge in south-west Alberta. Construction occurred between May 1 and November 30. The area is a winter range and lambing ground for 40-60 bighorn sheep. The area is also used during the fall. Animal distribution and behavior were monitored before and during construction activities. Industrial development *per se* did not cause bighorn sheep to abandon their traditional ranges or to alter their movement patterns. However, the attraction of the animals to wellsites, chemicals, fresh concrete, and other materials, and the animals mingling among industrial equipment was a significant concern.

In early 1986, as part of the on-going development of the Waterton Gas Field, Shell Canada Limited proposed drilling 2 wells (Wat 51 and Wat 52) on the Prairie Bluff Ridge, 18 km north of Waterton National Park. At that time, little was known of the spatial and temporal use of the area by bighorn sheep. In October 1986, Shell initiated an intensive monitoring study to provide baseline data on animal distribution and movements and to assess the impact of industrial development. Specific objectives included: 1) determine the timing and amount of bighorn sheep use of Prairie Bluff Ridge; 2) identify important feeding areas; and 3) monitor and assess reactions to construction, drilling and production activities. The study is continuing to assess the distribution of bighorn sheep and their use of Prairie Bluff 1 year after the end of construction activities.

The objective of this paper is to detail distribution before and during the development phase and the animal's response to industrial activities. We acknowledge G. Hoffman and T. Ross for their valuable field assistance throughout the study.

STUDY AREA

The Prairie Bluff complex consists of a series of high ridges and minor peaks south-west of Pincher Creek, in south-west Alberta. Elevation ranges 1,500-2,100 m. The area presents a high degree of physiographic and vegetational heterogeneity within 2 distinct eco-

regions. Above 1,800 m, the alpine region features rounded peaks and gently sloping ridges of stonefields and red argillites. On the east and south, vertical walls of limestone extend into the lower elevation subalpine region which is largely represented by the cliffs and scree and talus slopes below them. The alpine region supports widely dispersed grass-*Dryas* communities. In the subalpine, fescue (*Festuca scabrella*) communities are dominant, but vary in density and species composition depending on aspect, slope and underlying material.

When this study was initiated, in 1986, the regional bighorn population was recovering from a major pneumonia-related die-off. Prairie Bluff was believed to be used as winter range by about 30 bighorn sheep. However, the level of utilization and animal presence during other seasons were uncertain. The herd is hunted in the fall (rams only). Prior to Shell gas development, vehicular access to the Prairie Bluff ridges was limited to motorcycles and other all-terrain vehicles along an old trail.

METHODS

Timing of Construction Activities

To minimize the potential impact of industrial activities on bighorn sheep on Prairie Bluff, construction was limited to May-November and extended over 3 years, 1987-1989. On November 2, 1987, Shell begun construction of the access road and the preparation of the wellsites. Construction activities were suspended November 30, and resumed May 1, 1988. During the summer of 1988, after road construction was finished, Shell proceeded with gas well drilling. All activities were suspended again on November 30, 1988 and resumed May 1, 1989. In the summer of 1989, Shell constructed an underground pipeline along the access road. During this period, production buildings and equipment were erected on the wellsites, and a powerline was built following the access road. Vehicular access along the road was limited to Shell and construction personnel and government staff. The old trail was reclaimed, ending public vehicular access onto the ridges.

Animal Observations

The study began in October 1986, before the beginning of industrial activities (November 1987). Distribution and movement of sheep were studied with extensive ground surveys conducted at least 1 or 2 days a week. During the months of industrial activity (November 1987, May-November 1988, and May-June 1989), movements and distribution were monitored daily. The objective of daily monitoring was to determine the immediate impact of construction activities on the animals and, if needed, to advise and assist Shell Canada in minimizing it.

All wildlife observations and animal movements were recorded and marked on 1:20,000 vertical aerial photographs. Attempts were made to observe and video-document the responses of animals to identifiable activities such as rock blasting and helicopter flying.

RESULTS AND DISCUSSION

From October 1986 to October 1989, 449 days were spent in the field. Bighorn sheep were observed on 1,290 occasions, totaling 8,838 animals, including duplicate observations. Data from a separate radio-telemetry study (ewes and yearlings) indicated that the bighorn sheep of Prairie Bluff are part of a local population which does not travel to Waterton National Park (Morgantini unpubl. data).

Population Status and Lamb Production

During the winter of 1986-87, prior to Shell industrial development, Prairie Bluff wintered 18 ewes-yearlings, 10 lambs and 8 young rams. Two winters later, in 1988-89, at the end of construction activities, the herd had increased to 33 ewes-yearlings, 14 lambs and 9 young rams.

During the study, most lambing was found to occur on winter range, within 1,400 m of a wellsite. Shell activities on Prairie Bluff did not disrupt lambing or affect lambing habitats. At the end of May 1988, and in early June, after 1 month of wellsite construction, 11 lambs were born in the area, 50 % of the 1988 lamb production by the Prairie Bluff herd. The following year, 13 lambs were born on Prairie Bluff, 81 % of the 1989 lamb production. The lower production from the previous year is believed to be due to heavy snowfall and blizzard conditions that affected the area in late May-early June 1988.

Animal Distribution

Between 1987 and 1989, the industrial development of Prairie Bluff did not cause bighorn sheep to abandon their range and did not appear to permanently affect animal distribution. Figures 1-4 show the distribution of animals over the study area in winter, spring, summer, and fall, 1988 and 1989. Differences in numbers of observations between years reflect different numbers of field days.

A direct, significant impact on distribution was detected in only 2 instances. The first, in November 1987, when Shell began construction in the area, was caused by heavy helicopter activity. During that month, sheep reduced their use of Prairie Bluff, but re-established their traditional distribution in December, when construction was suspended. The second impact was noted in spring 1988, when bighorn sheep were heavily attracted to a wellsite by the presence of substances (drilling muds, oils, solvents, etc.) used during drilling operations (Figure 2). Due to that attraction, both wellsites were later fenced.

Behavioral Responses to Construction Activities.

Shell's operations were categorized as: helicopter support; caterpillar work, grading and vehicular traffic along the road and on wellsites; drilling for rock blasting and blasting; drilling rig operations; pipeline construction and wellsite activities.

Helicopter support.-- During November 1987, a helicopter was used to ferry fuel, people and equipment to the top of Prairie Bluff. A total of 247 flights with a Bell 212 (61.8 hrs) and 16 flights with a Bell 206 (4.7 hrs) were conducted, averaging 9 flights/day. Responses of sheep to helicopter flying were observed on 20 occasions (a total of 115 animals). In most cases (N=15, 76 animals) a significant behavioral response was detected. This consisted of increased level of alertness which was apparent before the observer could hear the helicopter. Reactions ranged from interrupted feeding and slow escape to panic fleeing. In 6 instances (42 animals), total disruption of activity and herd structure was detected. In 5 observations (39 animals) there was no apparent reaction. Nonetheless, it was evident that helicopter activity had an impact on bighorn sheep behavior and distribution in November. Subsequent to these observations, Shell abandoned the use of helicopters.

Caterpillar work, grading, and vehicular traffic.-- Disturbance associated with caterpillar operation and grading was minor because it was localized and with minimal noise. Further, to minimize any potential impact, Shell personnel had been instructed not to step off the road or approach any animal.

In general, bighorn sheep took little overt notice of activities along the road and were frequently seen grazing within 20 m of the road in spite of its construction, grading or passing vehicles (Figure 2). In many instances (N=19, 137 animals), sheep were observed on the road as a vehicle approached. Some of these encounters occurred when an animal crossed the road as a vehicle approached. But frequently, sheep appeared to be attracted to the road by previously spilled fluids (diesel, oil, concrete, etc.). In most cases, sheep moved off only to return onto the road after the vehicle had passed. On other occasions, however, the animals had to be herded off the road by the driver of the vehicle.

Rock drilling and blasting.-- Activities associated with rock drilling and site preparation for blasting did not appear to cause overt behavioral responses from bighorn sheep. On several occasions, animals grazed close to the site of activities (25 m) and had to be moved away before blasting could proceed. Blasting occurred along the road and on wellsites, in November 1987 and May 1988, and along the lower reaches of the road for pipeline construction, in June 1989.

Most blasting occurred in November 1987. During 19 days, approximately 42,899 kg of explosive were used in 22 blasts. Charges along the road were relatively small: 15 blasts averaging 53 kg/blast. Charges on wellsites were significantly larger: 7 blasts averaging 6,015 kg of explosive. Even though bighorn sheep were avoiding the area due to helicopter disturbance, their responses to blasting were observed in 8 instances (63 animals). In most cases (N=5, 52 animals), their reaction consisted of looking toward the blast followed by continued feeding. However, in all but 1 of these observations, the animals were more than 2 km distant and upwind (average wind speed: 10-15 km/hr). In 1 instance, 2 ewes and 1 lamb were grazing within 500 m from a road

blast site. As the blast occurred, the animals jumped and run for approximately 50 m. Then after watching for 120 seconds, they resumed feeding. In another observation, 4 ewes and 1 lamb, 2 km distant, fled as the blast occurred. A major impact was detected when 2 ewes and 1 lamb were 1.4 km distant, at the same elevation and in direct view, of a large blast (9,256 kg of explosive) on a wellsite. The animals fled over a ridge and remained restless, milling and looking around for 20 minutes.

In spring 1988 and 1989, rock blasting consisted only of small charges and was restricted to the lower section of the road. Responses of the animals ranged from an apparent total indifference to a startled reaction that consisted of either looking toward the source of the noise, or getting up and/or running for 5-10 m, then resuming their previous activity.

Pipeline construction.-- The underground pipeline from the Prairie Bluff wellsites to the Waterton Field gathering system was constructed during June-July, 1989. Due to the nature of pipeline construction (trenching, welding and backfilling) and its timing (during the lambing season), there were reasons for concern. An open trench, 1 m wide and 1 m deep, with pipe sections laying beside the trench on wooden blocks for welding, and an opposite dirt berm, could have been a hazard and a barrier for ewes and new-born lambs moving from lambing grounds onto summer ranges. Shell addressed these concerns by adopting an unusual construction schedule. No trench was left open overnight on the Prairie Bluff Ridge. In this area, every day, while a section of the trench was excavated, sections of pipe were welded together in another location. When the trench was completed, the welded sections were moved and laid in it. The trench was then backfilled. Further, movements of bighorn sheep were constantly monitored to detect when the animals were heading toward the area with the open trench and to warn construction personnel. This pipeline construction approach resulted in a slower schedule, but was effective in minimizing negative impacts. Ewes and new-born lambs were able to move through the construction area toward their summer range with minimal or no impediment.

Drilling rig operations and wellsite activities.-- Throughout the period of construction activities on Prairie Bluff, bighorn sheep were frequently observed grazing near wellsites. However, these results may be misleading. Direct responses of bighorn sheep to wellsite operations (drilling, servicing, etc.) cannot be assessed due to the attraction of the animals to materials on site. It is impossible to determine how the animals would have responded to the presence of a large drilling rig, and associated level of activities, had not they been attracted to the wellsites. During the winters of 1987-88 and 1988-89, with no construction activity in the area, the presence of wellsites and equipment did not affect bighorn sheep distribution, as they were frequently observed grazing near them (Figure 1).

Attraction to Materials on Wellsites and Along the Road

During summer 1988, when gas well drilling was underway, bighorn sheep ranged mostly on summer ranges, away from Prairie Bluff. In October, however, with increased use of the Prairie Bluff region, the animals detected materials on the wellsites and along the new road. These consisted of small amounts of fluids (drilling muds, oil, fuel, etc.) spilled off vehicles or during drilling operations. At that time, sheep were frequently observed licking along the road and milling around equipment on 1 wellsite. The attraction of the wellsite was solved by erecting a temporary fence.

Through winter 1988-89, bighorn sheep were occasionally observed eating dirt and licking the ground along the road and on the other wellsite. This attraction, however, did not significantly affect their distribution (Figure 1).

During April-June 1989, and to some extent over the summer, the attraction of bighorn sheep to industrial materials was a concern, and had a major impact on distribution (Figure 2). Prior to fencing the second wellsite, the animals had to be moved off frequently because they were interfering with construction activities. The attraction overrode any natural avoidance that the animals may have had about people or equipment. Bighorn sheep were seen eating fresh concrete, pipe insulation, paper, cardboard, twine, mulch, licking at powerpole insulators, at equipment, at various chemicals and fluids spilled on roads or on wellsites, etc. Animals were observed crawling under gates, crawling under fences, leaning with their front legs against fences, standing in the middle of the road licking contaminated soil irrespective of approaching vehicles, etc. This behavior is remarkable considering that 1) the Prairie Bluff herd is separate from the Waterton National Park herds; 2) animals were not habituated to human activities; and 3) rams are hunted in the fall.

Shell addressed the problem by effectively and permanently fencing the wellsites and all the disturbed soil around them with 2.5 m high chain-link. Shell also instructed personnel and contractors to maintain a clean site and to clean up spills immediately. It is expected that the attractive chemicals in the small areas of contamination along the road will be leached away by rain and snow.

The substance or substances that attract the animals are not known. Samples of contaminated soil and materials have been collected and are being analyzed.

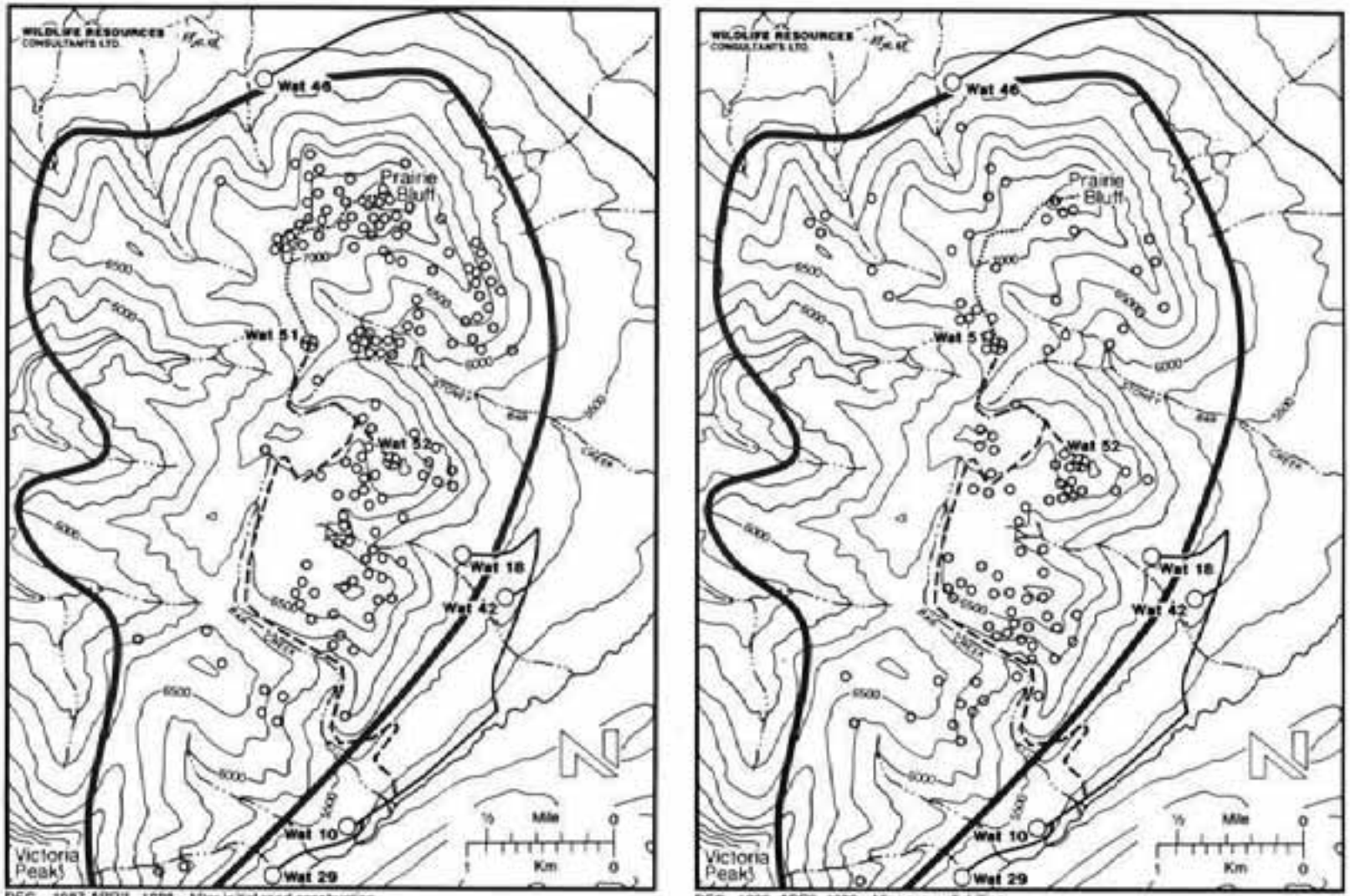
CONCLUSIONS

On a short term basis, the industrial development of Prairie Bluff, a prime winter range for bighorn sheep in southern Alberta, does not appear to have significantly impacted animal movements or distribution. How the herd will respond over the years is uncertain. At present, the 2 fenced wellsites are in production and servicing

traffic along the new road is limited to an average of 1 vehicle/day. No public motorized access is allowed.

The limited impact of construction activities is largely due to the mitigative measures adopted by Shell. The commitments to limit activities within the less critical period May-November, to restrict vehicular access along the new road, and to fence the 2 wellsites, in addition to a willingness to address potential wildlife conflicts as they occurred, significantly contributed to minimize impacts.

The attraction of bighorn sheep to materials used during industrial operations is a potential problem that should be considered whenever industrial activity on prime range is proposed. The attraction could affect animal distribution and lead to uneven range utilization. But, more important, it can lead bighorn sheep to display most unusual and unexpected behaviors. These can result in property damage or could harm the animals by exposing them to potentially toxic chemicals and industrial hazards.

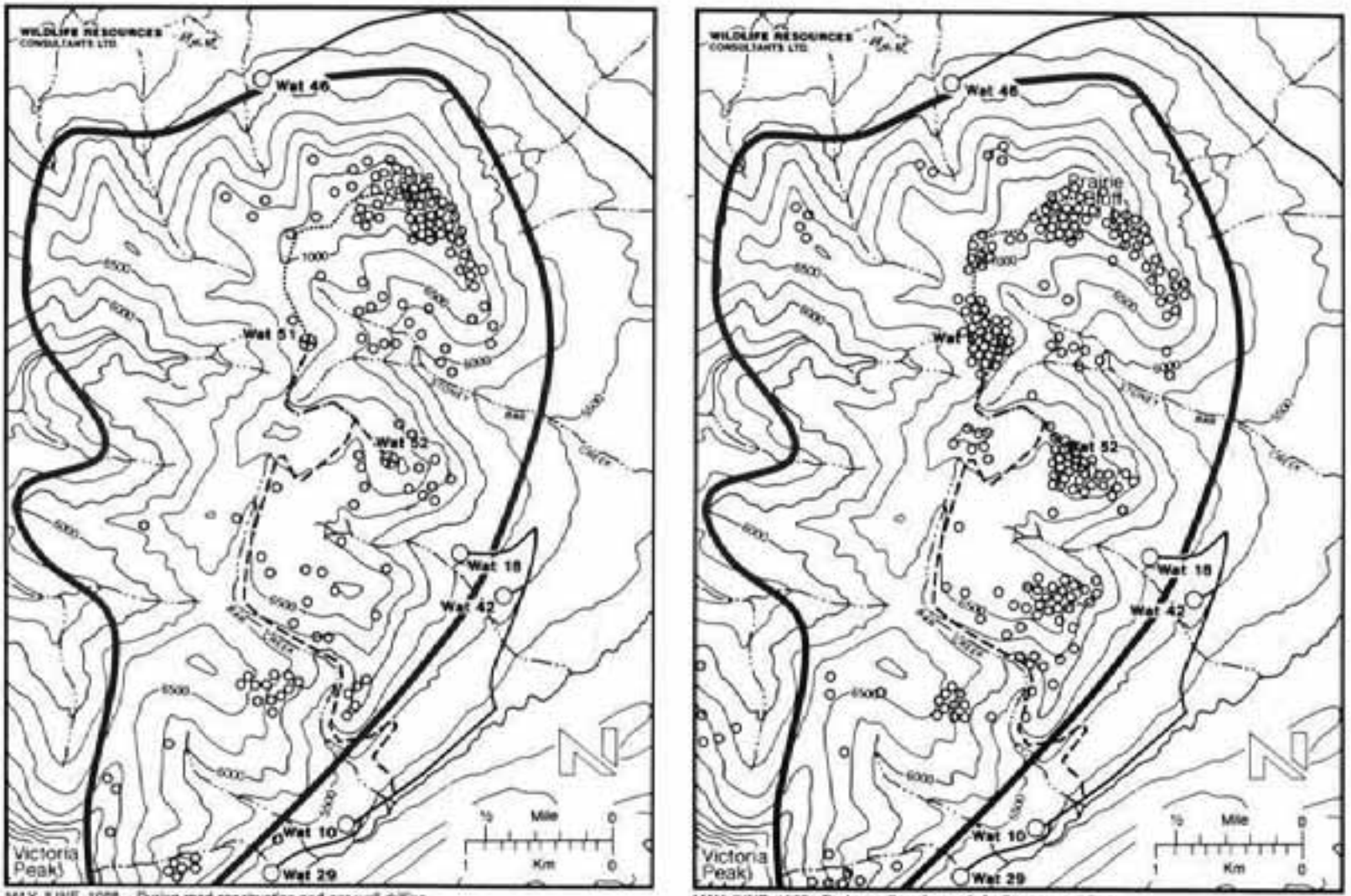


DEC., 1987-APRIL, 1988 - After initial road construction.
Based on observations made during 45 field days.

DEC., 1988- APRIL 1989 - After gas well drilling.
Based on observations made during 32 field days.

Service Road — New service Road — Upgraded Trail ····· Trail ■ Study Area Boundary

FIGURE 1 BIGHORN SHEEP SIGHTINGS, WINTER , 1987-88 AND 1988-89.

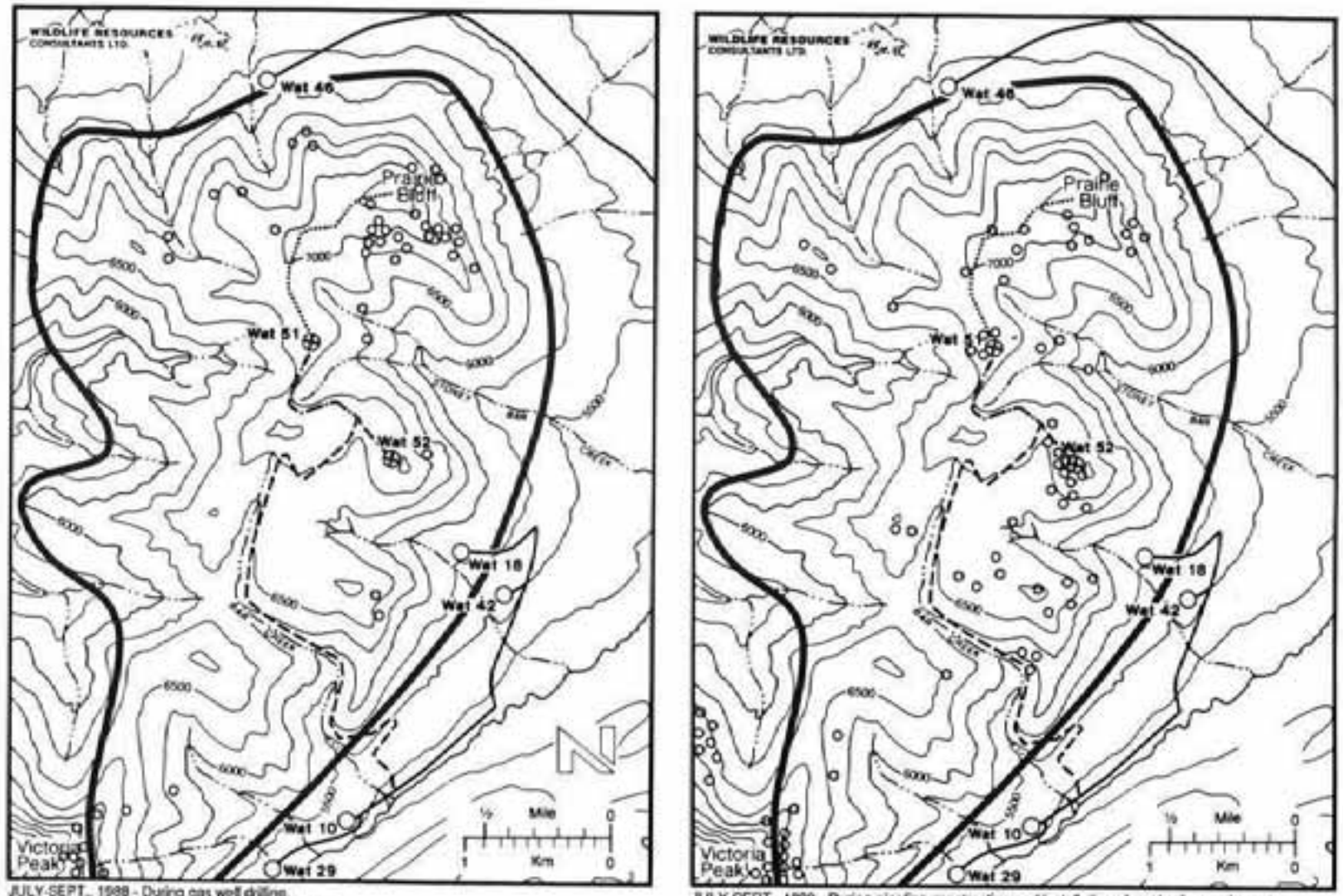


MAY-JUNE, 1988 - During road construction and gas well drilling.
Based on observations made during 61 field days.

MAY-JUNE, 1989 - During well testing and pipeline construction.
Based on observations made during 58 field days.

Service Road — — — New service Road —·— Upgraded Trail ·····Trail ■ Study Area Boundary

FIGURE 2 BIGHORN SHEEP SIGHTINGS, SPRING, 1988 AND 1989.

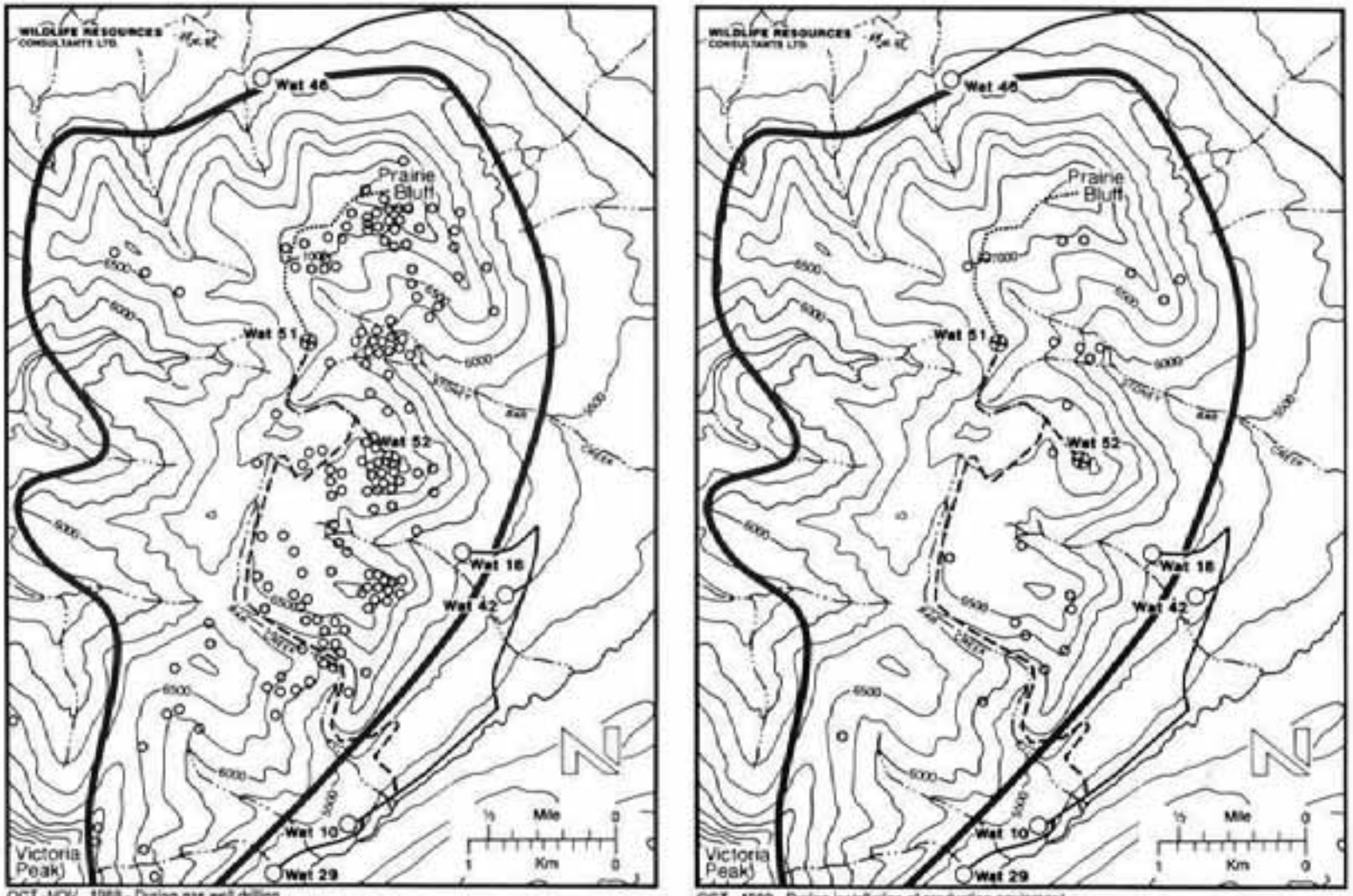


JULY-SEPT., 1988 - During gas well drilling.
Based on observations made during 27 field days.

JULY-SEPT., 1989 - During pipeline construction and installation of production equipment.
Based on observations made during 27 field days.

Service Road — New service Road — Upgraded Trail ····· Trail ■ Study Area Boundary

FIGURE 3 BIGHORN SHEEP SIGHTINGS, SUMMER, 1988 AND 1989.



OCT.-NOV., 1988 - During gas well drilling.
Based on observations made during 61 field days.

OCT., 1989 - During installation of production equipment.
Based on observations made during 7 field days.

Service Road — New service Road — Upgraded Trail ····· Trail ■ Study Area Boundary

FIGURE 4 BIGHORN SHEEP SIGHTINGS, OCT.-NOV., 1988 AND OCT. 1989.