PRELIMINARY ANALYSIS OF TRANSMISSION LINE IMPACT ON DESERT BIGHORN SHEEP MOVEMENT PATTERNS

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ABSTRACT.

Reported here are preliminary analyses of the impact of a 500 kV transmission line construction on seven radio collared desert bighorn sheep (Ovis canadensis mexicana) in the Dome Rock Mountains of western Arizona. Seven hundred four preconstruction relocations are compared to 365 construction period relocations. One ewe and one ram shifted their activity toward the area of transmission line construction, and two ewes appear to have slightly shifted their activity away from the construction activity. Two bighorn increased the number of times they traversed the line during the construction period.

INTRODUCTION

A seven year study of the impacts of construction and operation of the Devers-Palo Verde 500 kV transmission line on desert bighorn sheep in western Arizona began in 1977 (Stevens 1979). This line connects the Palo Verde Nuclear Generating Station near Phoenix, Arizona, and the Devers Substation near Palm Springs, California. This line traverses bighorn habitat in the Kofa National Game Range and in the Dome Rock Mountains, 48 kilometers and 24 kilometers east of the Colorado River respectively.

The transmission line traverses the Dome Rock Mountains through Copper Bottom Pass, crossing about 10 kilometers of bighorn habitat (Figure 1). An existing gas pipeline corridor was established through this pass during the 1940's. Transmission line construction occurred between March 1 and December 19, 1981. Preliminary analyses of construction effects on the Dome Rock Mountain herd are presented here.

METHODS

Twenty desert bighorn were originally captured in November 1977, and fitted with radio telemetry collars (Stevens 1979). Radio failures and sheep deaths necessitated additional captures between 1978 and 1981. Reported herein are data on seven Dome Rock sheep (three rams and four ewes) for which we have relocation data before and during construction (Table 1).

Locations of each collared animal were determined approximately every five days by aerial monitoring from a fixed wing aircraft. Additionally, ground based observations were made of these sheep since the time they were collared.

Five one-kilometer belts were drawn on topographic quads. The relocation data for each bighorn were plotted on these maps. The relative percent of relocations within each belt was determined and used as a gross estimate of the time each sheep spent within each defined area.

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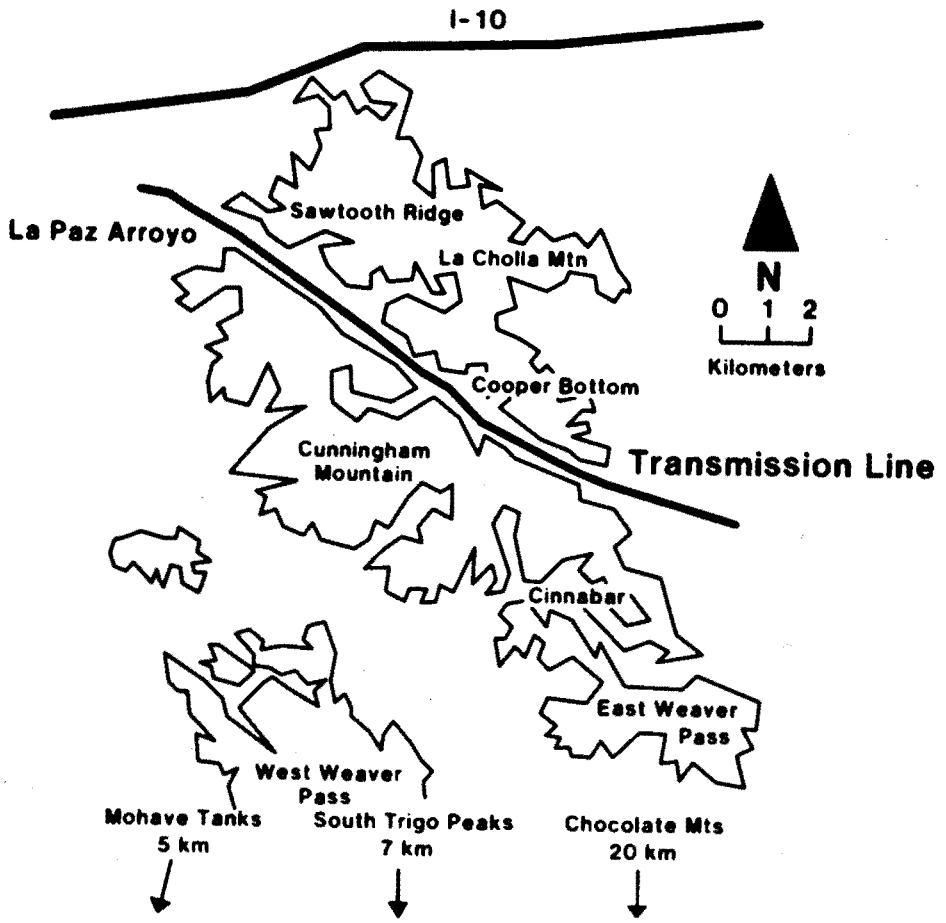

Figure 1. Dome Rock Mountains Study Area

Table 1. Sex, age and capture dates of radio collared desert bighorn sheep from the Dome Rock Mountains, Arizona

Number	Sex	Age of Capture	Capture Date
17 C/16B	Ram	1	November 27, 1978
9C	Ewe	3	November 1, 1980
5C	Ewe	Adult	November 29, 1979
3B	Ewe	Adult	November 27, 1978
20B/4C	Ewe	Adult	November 28, 1978
19B/15C	Ram	9	November 26, 1978
8C	Ram	9	March 20, 1980

RESULTS AND DISCUSSION

Construction related activities, such as number of personnel, type, and intensity of construction and noise levels were highly variable. The number of person days spent within the study area each week ranged from one to 187 weekly during the approximate seven and one-half month construction period. Construction activities consisted of cutting and grading of roads, clearing of tower sites, augering footing holes, pouring and casting footings, steel erection, conductor stringing and tensioning, and cleanup.

Table 2 presents the relative percents of relocations for the preconstruction and construction period. The data presented in Table 2 were analyzed using the Spearman Rank Correlation Coefficient (Zar 1974). The results are presented in Table 3.

Table 2. Percent of time each sheep spent within 1 kilometer increments of the transmission line corridor prior to construction (P) and during construction (C).

	N		1 Km		2 Km		3 Km		4 Km		5 Km		6 Km	
Sheep	P	C	P	C	P	C	P	C	P	C	P	C	P	C
17C/16B	166	50	0.6	0	0.6	0	1.2	0	2.4	1.8	15.6	16.7	79.6	81.5
9D	26	55	19.2	33.9	19.2	28.3	34.6	26.4	26.9	9.4	0	1.9	0	0
5C	93	54	23.9	24.5	41.3	37.7	26.1	17.0	7.6	11.3	0	9.4	1.1	0
3B	169	51	2.9	0	8.9	0	2.4	0	0.6	0	1.2	0	84.0	100.0
20B/4C	152	53	1.3	1.9	1.3	9.6	1.3	9.6	2.0	1.9	3.4	1.9	90.6	75.3
19B/15C	26	49	5.5	8.9	12.3	24.4	13.7	17.8	17.8	15.5	34.2	20.0	16.4	13.3
8C	72	53	9.7	17.6	20.8	17.6	23.6	11.8	9.7	27.4	23.6	9.8	12.5	15.7

Table 3. Results of Spearman Rank Correlation Coefficient of bighorn sheep relocations before and during transmission line construction.

Sheep	Presconstruction	Construction
17C/16B	0.99	0.94
9D	-0.50	-1.00
5D	-0.77	-0.94
3B	-0.29	0.65
20B/4C	0.94	0.31
19B/15C	0.83	0.03
8C	0.24	0.41

Another method used to evaluate construction related activity impact on this study population was an anlysis of the number of times each sheep crossed the transmission line corridor before and during construction (Table 4).

Ram 17C/16B spent most of his time outside the five kilometer area before and during construction. The majority of relocations before and during construction were concentrated in two areas, both more than four kilometers south of the line. He moved over a slightly larger area during the first two years after being captured, and this may have been age related. He did not cross the line either before or during construction. Spearman Rank Correlation Coefficient results indicate a strong relationship between relocations and distance

Table 4. Dome Rock sheep crossing of the transmission corridor before and during construction, and crossing per week of monitoring. N = number, N/W = number per week of monitoring.

Sheep	Preconstruction N	Preconstruction N/W	Construction N	Construction N/W
17C/16B	0		0	
9D	0		9	0.21
5C	8	0.12	22	0.51
3B	2	0.02	0	
20B/4C	4	0.03	0	
19B/15C	10	0.32	8	0.19
8C	9	0.18	7	0.16

from the line both before and during construction (Table 3). This relationship is probably a reflection of this animal's home range centering more than four kilometers south of the line (Table 2).

Aftercollaring, ewe 9D spent all of her time within five kilometers of the line. There is a weak relationship of relocations in relation to distance prior to construction ($r = -0.50$), but an extremely strong negative relationship during construction ($r = -1.00$). Additionally, she was not known to cross the transmission corridor prior to construction but crossed at least nine times during construction. These results suggest 9D may have been attracted to the construction activity.

Ewe 5C spent 98.9% of her time within five kilometers of the line prior to construction. During construction she spent 90.6% of her time within the same distance. Her movement patterns and amount of time spent within the five kilometer study area indicate there was not a major shift in relocations during construction (preconstruction $r = -0.77$, construction $r = 0.94$). The number of transmission corridor crossings more than doubled during construction (Table 4). The increase in crossings suggests she may have been attracted to the construction activity.

Ewe 3B shifted from 84.0% of her time more than five kilometers from the line prior to construction to 100% during construction. This animal shifted her home range away from the line during construction resulting in a home range confined to West Weaver Pass (preconstruction $r = -0.29$, construction $r = 0.65$). She crossed the line twice prior to construction but not during construction.

The comparisons of the two study phases for ewe 20B/4C are similar to ewe 3B. She spent most of her time more than five kilometers from the line. She used approximately the same area during both study phases but confined more of her relocations in the West Weaver Pass area. She had crossed the line four times prior to construction but not during construction. The Spearman Rank Correlation Coefficient (Table 3) indicates a shift in use patterns. In relationship to construction impact, this may not be an important shift since prior to construction most of this animal's time was spent a considerable distance from the line.

Ram 19B/15C divided his use patterns north and south of the line. The Spearman Rank Correlation Coefficient (Table 3) indicate a shift in activity. He spent more time within three kilometers of the line during construction than prior to construction (43.8 percent preconstruction, 82.3 percent construction). The number of corridor crossings were about equal.

Ram 8C's relocation patterns and number of crossings (Tables 2 and 4) remained quite similar between the two study periods.

CONCLUSION

The analysis of these seven Dome Rock Mountains sheep relocations and transmission line corridor crossings before and during construction are preliminary. There is a third phase of the study presently in process. This relates to the effect of the transmission line operation. Once this latter phase is completed a rigorous analysis of all data will be performed.

This initial examination of preconstruction verses construction relocations tend to indicate that construction activities may have drawn two animals toward the area of impact (9D, 19B/15C). Ewes 9D and 5C both significantly increased the number of transmission line crossing during construction. Two animals (3B and 20B/4C) showed evidence of shifting habitat use away from the area of construction activity. The data on ram 8C do not indicate a response to the construction.

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