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Condor, 80:444–446

EFFECT OF A NEW TRANSMISSION LINE ON WINTERING PRAIRIE RAPTORS

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Most birds of prey hunt from a perch that provides a commanding view of the hunting area (Brown and Amadon, p. 70–71, Eagles, hawks, and falcons of the world, McGraw-Hill, New York, 1968). Hillsides, rocky outcrops, and trees along streams provided perches on the Great Plains before the arrival of modern man. Man has erected many structures, particularly fenceposts, power poles, and windmills, that have subsequently been used as perches by prairie raptors. Marion and Ryder (Condor 77:350–352, 1975) found that Golden Eagles (*Aquila chrysaetos*), Rough-legged Hawks (*Buteo lagopus*), and Prairie Falcons (*Falco mexicanus*) preferred higher man-made perches. As part of a study of the effects of a new 230 kV transmission line on prairie wildlife, I counted raptors along its right-of-way during the winters of 1973–74 (before construction) and 1974–75 (after construction). This note reports the effect that this new line had on the local distribution and numbers of wintering diurnal raptors.

STUDY AREA AND METHODS

The transmission line, which dominates the prairie skyline, extends 125 km from the Midway Substation, 32 km S of Colorado Springs, Colorado, across gently rolling terrain to the Big Sandy Substation, 4 km NE of Limon, Colorado. Wooden H-frame towers which are 23 m high support three conductors and two overhead ground wires. Shortgrass prairie, dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*), occurs along 70 km (56%) of the line. Sandhill prairie, predominately sandhill bluestem (*Andropogon hallii*), and sandreed (*Calamovilfa longifolia*), occupies 29 km (23%) of the line, while cropland, primarily winter wheat (*Triticum anetivum*), underlies 25 km (20%) of the line. One km (1%) of the line crosses the predominately cottonwood (*Populus sargentii*) flood plain of Fountain Creek, the area's only permanent stream.

I counted raptors along 80 km of the line, primarily in shortgrass and sandhill prairie, approximately every two weeks between mid-November and mid-March each year. Most of the census route was on county and primitive roads near the powerline right-of-way (ROW) because fencelines impeded ROW travel before access gates were built. Each count began within an hour after sunrise and continued

TABLE 1. Proportional use of perch types by diurnal raptors observed *beyond* 0.4 km of the transmission line during winter censuses before and after construction.

			Proportion of perched raptors on				
Species	Time period	No. perched	REA pole	Fence-post	Tree	Wind-mill	Other
Rough-legged Hawk	before	15 (15)[1]	.60	.20	.00	.07	.13
	after	19 (23)	.53	.10	.16	.16	.05
Golden Eagle	before	12 (15)	.33	.25	.08	.25	.08
	after	10 (15)	.20	.40	.20	.10	.10
Prairie Falcon	before	3 (4)	.67	.33	.00	.00	.00
	after	5 (6)	.80	.20	.00	.00	.00
All raptors[2]	before	39 (53)	.44	.26	.10	.10	.10
	after	48 (71)	.42	.25	.15	.10	.08

[1] Number seen.
[2] Includes nine species.

TABLE 2. Proportional use of perch types by diurnal raptors observed *within* 0.4 km of the transmission line during winter censuses before and after construction.

Species	Time period	No. perched	Proportion of perched raptors on Tower	REA pole	Fence-post	Tree	Wind-mill	Other
Rough-legged Hawk	before	9 (13)[1]	—	.33	.33	.00	.33	.00
	after	37 (37)	.89	.08	.00	.00	.03	.00
Golden Eagle	before	5 (7)	—	.20	.20	.00	.60	.00
	after	27 (28)	.78	.00	.00	.00	.00	.22
Prairie Falcon	before	4 (6)	—	.50	.00	.25	.25	.00
	after	8 (10)	.88	.00	.12	.00	.00	.00
All raptors[2]	before	19 (29)	—	.32	.21	.05	.37	.05
	after	81 (88)	.81	.05	.03	.00	.01	.10

[1] Number seen.
[2] Includes seven species.

until completion, 6–7 hours later. All counts were conducted on days with light winds (0–4.5 m/s) (Enderson, Wilson Bull. 72:222-231, 1960). I watched for raptors while driving 15–50 km/h and stopped occasionally to scan with 8 × 40 binoculars. When a raptor was seen, its species, location, and activity were recorded. Binoculars and a 15–45× spotting scope aided identification.

The area within view of the census route was outlined on a map and then measured with a planimeter. A total of 155 km^2 were within the census area. Census data were converted into raptors per 100 km^2 to compare the study area populations between the two years. I also subdivided the study area into zones less than and more than 0.4 km of the ROW in order to examine perch site preferences and the effect of the line on the distribution of the local population. There were 57 km^2 within and 98 km^2 beyond 0.4 km of the ROW.

RESULTS AND DISCUSSION

Nine species of diurnal raptors were observed during winter censuses. Rough-legged Hawks and Golden Eagles were the most common, comprising nearly two-thirds of the total sightings. Ferruginous Hawks (*Buteo regalis*), Prairie Falcons, Marsh Hawks (*Circus cyaneus*), and American Kestrels (*Falco sparverius*) were seen on most counts, but Goshawks (*Accipiter gentilis*), Bald Eagles (*Haliaeetus leucocephalus*), and Merlins (*F. columbarius*) were sighted only occasionally.

Between the two winters there was little change in the kinds and numbers of perch sites available in the census area except for the addition of 320 transmission towers. Those raptors sighted more than 0.4 km from the ROW chose perches in approximately the same proportions both years (Table 1). However, the towers were used extensively by raptors within 0.4 km of the ROW in 1974–75. Although towers were only 1.5% of the available perches in 1974–75, 81% of all perched raptors seen were on them. Rough-legged Hawks, Golden Eagles, and Prairie Falcons all used towers more than all other perches combined (Table 2).

Distribution of local raptors was changed by the presence of the towers (Table 3). Raptor densities within and beyond 0.4 km were not significantly different ($\alpha = .05$) before construction ($P = 11$, $cv = 2$, signed rank test for paired non-parametric data; Snedecor and Cochran, Statistical methods, Iowa State Univ. Press, Ames, 1967). After construction, however, raptor density within 0.4 km was significantly greater ($\alpha = .01$) than that beyond 0.4 km ($P = 0$, $cv = 0$).

The population in the total census area was significantly greater after construction ($\alpha = .01$) than before (Table 3; $T = 30$, $cv = 32$; two sample rank test, non-parametric data; Snedecor and Cochran 1967). Raptors were more conspicuous when perched on towers, which probably accounts for part of the apparent increase. Unfortunately, I have no census data on a control population, so I do not know if the increase was localized, and thus a result of the

TABLE 3. Raptors/100 km^2 within 0.4 km, beyond 0.4 km, and in the total census area along the raptor census route of the transmission line in 1973–74 and 1974–75.

Period of count	1973–74 Within 0.4 km	1973–74 Beyond 0.4 km	1973–74 Total area	1974–75 Within 0.4 km	1974–75 Beyond 0.4 km	1974–75 Total area
16–30 November	10.9	11.5	11.3	23.2	11.8	15.9
1–15 December	3.6	13.4	10.0	30.2	20.5	23.8
1–15 January	10.6	14.3	12.9	23.0	10.2	14.9
16–31 January	12.7	12.5	12.7	21.2	13.3	16.2
1–14 February	7.1	4.1	5.2	21.2	8.2	12.9
15–28 February	12.4	5.1	7.8	23.0	5.1	11.6
1–15 March	5.3	8.2	7.1	31.9	5.1	14.9

construction of the line, or whether there was a greater influx of raptors into east-central Colorado in 1974–75 than the previous year.

This paper describes part of the results obtained from a Master of Science thesis at Colorado State University. I was supported by the Tri-State Generation and Transmission Association and the Colorado Division of Wildlife. I thank A. W. Alldredge and R. A. Ryder for their guidance throughout the study and their critical review of an earlier draft of this manuscript. M. Harle, O. M. Degerness, and J. E. Pope of Tri-State assisted with logistics throughout the study.

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Condor, 80:446

UNILATERAL LAPAROTOMY AS A TECHNIQUE TO ASSAY AVIAN GONADAL CYCLES

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The technique for performing unilateral laparotomy on small birds as described in detail by Risser (Condor 73:376, 1971) facilitates several types of biological investigations including: a) sex determination in sexually monomorphic species, b) placement of electronic devices within the peritoneal cavity to transmit certain physiological measurements and, c) in situ monitoring of the gonadal cycle from individual birds without requiring that the animal be sacrificed. Essentially, the unilateral laparotomy technique involves a small surgical incision in the abdominal wall through which the gonad can be seen and measured. Birds recover rapidly after the operation and the incision usually heals within two weeks.

Although this technique has been used to assay avian gonadal cycles for at least twenty years (Miller, Caldasia 8:295, 1958), Hamner (Ecology 49:211, 1968) first reported that "repeated laparotomy does not alter the testis cycle." However, he did not present supporting data. Thus, potential effects, or the lack thereof, of unilateral laparotomy on the gonadal cycle in birds remained undocumented. The purpose of this paper is to report the results of an experiment specifically designed to discover whether repeated unilateral laparotomy has an overt effect on the testicular cycle of the Starling (*Sturnus vulgaris*).

Immature male Starlings were captured during the early summer from the San Joaquin Valley, Solano Co., California and held under natural photoperiods (Lat. 38° N) in an outdoor aviary at Davis, California. Food (turkey pellets) and water were provided ad libitum. On 23 January 1967, just prior to the time when spontaneous gonadal metamorphosis could be expected, ten birds were randomly selected from this captive population and tagged with numbered leg bands. The testicular size of these Starlings was assayed via repeated unilateral laparotomy at about 3-week intervals. On the date of each assay, another ten birds were removed from the parent flock and the testis in each bird measured via laparotomy. Subsequently, these ten 10-bird groups were tagged with colored leg bands so that they could be recognized and not subjected to a second laparotomy. They were then returned to the population to maintain constant numerical density within the cage.

The testicular size (width of the left testis) was monitored from the experimental group and the control groups at ten dates spanning the gonadal growth-involution phase of the annual reproductive cycle in Starlings at this latitude (Table 1). At no time during the test was the testicular size of the experimental group and the corresponding control group significantly different ($P > 0.05$, Student's t-test, two-tailed). Thus, neither the duration of the testicular growth-involution phase, nor the rate of testicular metamorphosis within this phase was affected by repeated unilateral laparotomy. I conclude that this technique can be used, at least at 3-week or longer intervals between laparotomies, without danger of experimental error.

TABLE 1. Statistical description (mean, standard error, and range) of testicular growth-involution cycles in laparotomized Starlings.

Date 1967	Single laparotomy $\bar{x}$	SE	Range	Multiple laparotomy $\bar{x}$	SE	Range
23 Jan.	2.0*			2.0		
12 Feb.	2.4	0.20	2.0–3.9	2.4	0.17	2.0–3.5
2 Mar.	4.9	0.63	2.7–8.3	4.6	0.41	3.0–7.0
22 Mar.	7.0	0.27	5.1–8.0	7.1	0.42	4.0–8.5
11 Apr.	7.8	0.15	7.0–8.5	7.7	0.14	7.0–8.2
1 May	7.4	0.56	3.2–9.3	7.5	0.21	6.1–8.2
22 May	5.1	0.67	2.0–8.5	5.0	0.52	3.0–7.3
9 June	2.1	0.04	2.0–2.3	2.1	0.05	2.0–2.5
30 June	2.0	0.01	2.0–2.1	2.0	0.02	2.0–2.2
20 July	2.0			2.0		

* Values represent width of left testis in mm. Testis widths below 2.0 mm cannot be measured accurately via laparotomy and were mathematically considered as "2.0 mm" although in vitro measurements of testicular widths in previous experiments indicate that quiescent testes in this species may be as little as 1.0 mm wide.

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