TEMPORAL FLUCTUATIONS OF ROUGH-LEGGED HAWKS DURING CARRION ABUNDANCE

JAMES W. WATSON

Rapid local population changes in the wintering Rough-legged Hawk (*Buteo lagopus*) have been attributed to the movement of hawks following snowfall (Schnell 1967, 1968; Thurow et al. 1980) sometimes accompanied by dietary shifts to carrion (Klein and Mason 1981). When Black-tailed Jack Rabbit (*Lepus californicus*) populations peaked in southeastern Idaho in early 1980 (Stoddart 1983), rabbit carrion was overly abundant and available to the hawk population. To assess the influence of carrion abundance, snow depth, and minimum daily temperature on the seasonal abundance of hawks, I conducted a roadside raptor survey in winter 1982-83 and analyzed the association of these variables to hawk numbers by stepwise multiple regression (Zar 1974).

The 187 km survey was conducted weekly on the Idaho National Engineering Laboratory (INEL) between 11 November 1982 and 20 March 1983. Big sagebrush (*Artemisia tridentata*) and grass (*Agropyron* spp.) understory vegetation dominated along the survey route, which included 16.7 km of agricultural fields. A more complete description of vegetation patterns was given by Harniss and West (1973). To standardize the influence of wind and time of day on hawk behavior, surveys were conducted on calm, dry days between 0800 H and 1300 H MST but were occasionally delayed due to inclement weather. Vehicle traffic was consistently low on the INEL due to restricted public access and not considered to be an important influence on hawk numbers. The vehicle route and other survey methods followed that described by Craig (1978). Road-killed rabbits were tallied each survey and weather information was supplied by National Oceanographic and Atmospheric Administration (NOAA) (Central Facilities Area, INEL). Stepwise addition of variables (Zar 1974) was used to fit regressions, and the regression with the highest R^2adj value judged to be the most suitable model.

A maximum of 53 and a minimum of 0 hawks were seen during 18 surveys ($\bar{x} = 33 \pm 12$ hawks/survey). Rabbit carcasses counted during surveys varied from 0 to 268 ($\bar{x} = 80 \pm 90$ carcasses/survey). Temperatures between October and April 1982-83 averaged 1.7° C, or 0.7° C above normal, and precipitation averaged 2.2 cm, or 0.4 cm above normal.

Single factor regression of hawks on carrion abundance, snow depth and minimum daily temperataure on the day prior to the survey were significant ($P < 0.05$), and explained 56.1, 26.1 and 29.9% of the variability in hawk numbers, respectively. Due to a difference in hawk counts observed for snow depths less than and greater than 10 cm, hawk counts were regressed on rabbit counts and a dummy varible (Zar 1974; Montgomery and Peck 1982) indicating snow depths of at least 10 cm. The addition of this variable was significant (R^2adj = 0.65, $P < 0.001$). Addition of temperature and actual snow depths did not improve this reression (R^2adj = 0.61) and the following was determined to be the model which explained the most variation in hawk counts:

$$\hat{Y} = 19.09 + 0.07x_1 + 10.98x_2$$

Where Y = hawk count
X_1 = rabbit count
X_2 = 1 if snow depth > 10 cm, 0 if < 10 cm

Rough-legged Hawks have been described as "microtine specialists" that can shift to other prey when voles are unavailable (White and Cade 1971). Snow depths, particularly above 10 cm, likely precluded small mammal use by hawks and they moved to roads to take advantage of increased carrion. Road-killed rabbits, which were the primary source of carrion, created a phenomenon similar to that for Bald Eagles (*Haliaeetus leucocephalus*) attracted to fish killed by powerplant operations (Ingram 1965) or fluctuations in water release rates at dams (Steenhof 1976). In both situations, a human-caused superabundance of carrion served to attract physiologically stressed raptors during winter. Such conditions probably "short-stopped" some Rough-legged Hawks migrating through the Snake River Plain during the early and latter part of the survey period, and accounted for a portion of the winter hawk population. Hawk counts were known to reflect the presence of transmitter-equipped resident hawks which shifted foraging territories to highways during inclement weather in winter 1982-83 (Watson 1984).

Although this species is known to take a variety of avian and mammalian prey (see review by Sherrod, 1978), prior accounts of carrion consumption (Weller 1964; Schnell 1967) are qualitative with carrion forming an insignificant portion of the total diet During winter 1982-83, leporids comprised 48.6% of prey numbers and 70.1% of biomass of prey consumed by Rough-legged Hawks, whereas voles comprised 41.3% and 9.6%, respectively (Watson 1984). The reported variability in the consumption of carrion and movement of hawks to roads in cold weather (Schnell 1968; Bildstein 1978; Fleming 1981; Klein and Mason 1981), is evidently linked to winter range character. When snow cover reduces rodent availability, Rough-legged Hawks have the option of switching to alternate prey such as carrion, if it is available, or relocating to other areas.

ACKNOWLEDGMENTS

This research was a contribution of the INEL Radioecology and Ecology Program, funded by the Office of Health and Environmental Research, Department of Energy in cooperation with the Fish and Wildlife Program, Department of Biology, Montana State University. Published as Journal Series No. 1729, Montana Agricultural Experiment Station. Thanks are extended to R.L Eng, J.W. Grier, R.P. Howard and O.D. Markham for reviewing drafts of this note and to H. Lee, K. McGarigal and R.A. Watson for assistance.

LITERATURE CITED

BILDSTEIN, K.L. 1978. Behavioral ecology of Red-tailed Hawks (*Buteo jamaicensis*), Rough-legged Hawks (*B lagopus*), Northern Harriers (*Circus cyaneus*), American Kestrels (*Falco sparverius*) and other raptorial birds wintering in south central Ohio. Ph.D. Diss., Ohio State Univ., Columbus. 364 pp.

CRAIG, T.H. 1978. A car survey of raptors in southeastern Idaho 1974-76. *Raptor Res.* 12:40-45.

FLEMING, T.L. 1981. A 3-winter raptor survey of the Columbia Basin, Washington/Oregon. U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S Bureau of Land Management, WA. 143 pp.

HARNISS, R.O. AND N.E. WEST. 1973. Vegetation patterns of the National Reactor Testing Station, southeastern Idaho. *Northwest Sci.* 47:30-43.

INGRAM, T.N. 1965. Wintering bald eagles at Guttenburg, Iowa - Cassville, Wisconsin, 1964-65. *Iowa Bird Life* 35:66-78.

KLEIN, R.J. AND D.R. MASON. 1981. Change in raptor hunting behavior following heavy snowfall. *Raptor Res.* 15:121.

MONTGOMERY, D.C. AND E.A. PECK. 1982. Introduction to linear regression analysis. John Wiley and Sons, Inc., New York, NY. 504 pp.

SCHNELL, G.D. 1967. Population fluctuations, spatial distributions, and food habits of Rough-legged Hawks in Illinois. *Kansas Ornith. Soc. Bull.* 18:21-28.

__________. 1968. Differential habitat utilization by wintering Rough-legged and Red-tailed Hawks. *Condor* 70:373-377.

SHERROD, S.K. 1978. Diets of North American falconiformes. *Raptor Res.* 12:49-121.

STEENHOF, K. 1976. The ecology of wintering bald eagles in southeastern South Dakota. M.S. Thesis. Univ. of Missouri, Columbia. 148 pp.

STODDART, L.C. 1983. Relative abundance of coyotes, lagomorphs and rodents on the Idaho National Engineering Laboratory, pp. 268-277. *In* 1983 Progress Report, Idaho National Engineering Laboraory Radioecology and Ecology Programs, ID-12098. Nat. Tech. Inf. Serv., Springfield, VA.

THUROW, T.L., C.M. WHITE, R.P. HOWARD AND J.F. SULLIVAN. 1980. Raptor ecology of Raft River Valley, Idaho. EGG-2054. Idaho Falls, ID. 45 pp.

WATSON, J.W. 1984. Rough-legged Hawk winter ecology in southeastern Idaho. M.S. Thesis, Montana St. Univ., Bozeman. 101 pp.

WELLER, M.W. 1964. Habitat utilization of two species of buteos wintering in central Iowa. *Iowa Bird Life* 34:58-62.

WHITE, C.M. AND T.J. CADE. 1971. Cliff-nesting raptors and ravens along the Colville River in Arctic Alaska. *Living Bird* 10:107-150.

ZAR, J.H. 1974. Biostatistical analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ. 620 pp.

Department of Biology, Montana State University, Bozeman, MT 59717. Present address: RR 1 Box 860-A, Warrenton, Oregon 97146.

Densities of Red-tailed Hawk Nests in Aspen Stands in the Piceance Basin, Colorado

MIKE MCGOVERN AND JOHN M. MCNURNEY

This note describes dissimilar nesting densities of the Red-tailed Hawk (*Buteo jamaicensis*) in 2 areas in Colorado. Although Red-tailed Hawks nest in a variety of habitats (Knight et al. 1982; Smith and Murphy 1982) hawks were observed nesting only in aspen (*Populus tremuloides*) trees.

Between 21 June and 1 July 1983, Red-tailed Hawk nests were surveyed in pure stands of aspen in 2 areas (designated A and B) in the Piceance Basin, Garfield County, Colorado. Areas A and B are approximately 38 and 28 km, respectively, north of Debeque, Mesa County, Colorado, at elevations between approximately 2400 and 2500 m. Both areas have similar types of vegetation. Area A was 28.7 km^2 in size and contained 24 aspen stands covering 3.1 km^2. Area B was 14.0 km^2 in size and contained 17 aspen stands covering 2.8 km^2. The remainder of the areas consisted primarily of shrubs (1 to 3 m in height) including mountain mahogany (*Cercocarpus montanus*), serviceberry (*Amelanchier utahensis*), Gambel oak (*Quercus gambelii*), big sagebrush (*Artemesia tridentata*) and others, with occasional areas composed of annual grasses.

Surveys of all aspen stands in both areas were done by helicopter (approximately 40% of the survey) or on foot. For those stands surveyed on foot, transects were walked at 50-m intervals following the elevational contours of each stand until all trees were examined. Nests were deemed occupied if young were seen in the nest, if the nest was recently decorated by greenery, or if a nest was defended by an adult hawk. Locations of occupied nests were marked on 7.5-min topographical maps. Nearest neighbor analyses (Clark and Evans 1954) were conducted to determine if hawk nests were spaced randomly throughout each area.

Density of occupied nests was one/5.74 km^2 on area A, and mean distance between nests was 2.23 (± 0.46 S.D.) km. Mean distance between nests in area B was 0.68 (± 0.33 S.D.) km, with 1 breeding pair/2.00 km^2. Mean density of nests and distances between nests on areas A and B were comparable with data found in the literature (Table 1). However, mean distance between nests on area B (0.68 km) was lower than all values reported (Table 1).

In area A, nearest neighbor analysis indicated that occupied nests tended toward uniform distribution and were significantly different from random ($R = 1.84$; $c = 3.60$, $P < 0.01$). In area B, occupied nests were not significantly different from random distribution ($R = 1.19$; $C = 0.93$, $P < 0.10$). The percentage of area covered by aspen on area A (11%) was less than that of area B (20%). In addition, there were more trees within the aspen stands on area. A that were small (3-5 m high) (R.W. Beck and Associates 1983a, 1983b) and apparently ill-suited for Red-tailed Hawk nest sites. Therefore, available nesting habitat in the vicinity of occupied nests in area A may have been more limited than in area B. Indeed, there was a mean of 0.60 km^2 (range = 0.01 - 1.14 km^2) of suitable nesting habitat (trees > 5m in height) within a 1-km radius of the nests in area A. In area B there was a mean of 1.04