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RAPTOR RESEARCH

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HISTORY AND PRESENT STATUS OF SWAINSON'S HAWKS IN SOUTHEAST OREGON

Carroll D. Littlefield, Steven P. Thompson and Bradley D. Ehlers

Abstract - Similar to other isolated localities, Swainson's Hawks have declined in southeast Oregon. Formerly, the most commonly nesting *Buteo* in the Malheur-Harney Lakes Basin, the species became uncommon after the 1950's. Population declines have also been noted during migration. Reasons for the decline are unknown, but several theories are presented.

Declines in Swainson's Hawk (*Buteo swainsoni*) numbers have been reported from California (Bloom 1980), Nevada (Herron and Lucas 1968) and southern Saskatchewan (Houston and Bechard 1983). Here, we report a similar decline in southeast Oregon. A summary of the species' nesting and migratory status is given from 1875 through 1983, based on U.S. Fish and Wildlife Service (FWS) files, and reports by early ornithologists who worked in the Malheur-Harney Lakes Basin. Data were limited in certain periods, but enough accounts have accumulated to provide a general trend for the region.

Study Area

Most information has been collected on or near Malheur National Wildlife Refuge Harney Co., Oregon (Figure 1). The refuge consists of 73,219 ha of freshwater marshes, two large lakes and uplands with big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* spp.) and/or greasewood (*Sarcobatus vermiculatus*). Many km of riparian habitat are available along water systems, particularly in the southern portion of the refuge. The main units are Malheur, Harney and Mud lakes, Double O and Blitzen Valley. The Blitzen Valley contains the most important habitat for Swainson's Hawks because of the amount of riparian vegetation present. The valley extends south from Malheur Lake about 67 km.

Surrounding the refuge are great expanses of shrub-steppe. Big sagebrush is the dominant plant, but in many regions western juniper (*Juniperus occidentalis*) is characteristic (Franklin and Dyrness 1973). Within this shrub-steppe region the Bureau of Land Management (BLM), in cooperation with the U.S. Fish and Wildlife Service, conducted a nesting raptor inventory from 1976 through 1980. Malheur NWR was located within the 26,379 km^2 raptor inventory area; however, most of the study area was on lands administered by the BLM (Figure 1). Information from the BLM study are included in this report.

Southeast Oregon is within the Basin and Range province, and is a continuation of this physiological province in Utah, Nevada, Arizona, New Mexico and California. The province is mostly about 1200 m elevation, with north-south trending fault-block mountains and basins of internal drainage (Baldwin 1964). The highest point in southeast Oregon is Steens Mountain, Harney Co., which attains an elevation of 2958 m.

Nesting habitat for Swainson's Hawks has been riparian zones on Malheur NWR, and widely scattered junipers throughout the surrounding uplands. In the spring, the species is usually seen near agricultural areas, while in the fall principle feeding habitat is newly mowed meadows where an abundance of rodents, particularly montane voles (*Microtus montanus*), are left exposed.

Materials and Methods

Most records were obtained from Malheur NWR files and early documents from ornithologists who worked in the region from 1875 through 1932. From 1940 through 1983 information was primarily from Malheur NWR Annual Narrative Reports (NR). Beginning in 1975, 360 km of raptor road counts were initiated on and surrounding the refuge (Figure 2). During the periods when Swainson's Hawks were in the basin, surveys were conducted in April, June and August 1975, 1977, 1979, 1980, 1982 and 1983. Transects were driven at 32 kph with stops for 3 min every 1.6 km. Counts were completed between 10:00 and 15:30.

Results

1875-1939. — Swainson's Hawks were first recorded in southeast Oregon in 1875 when Charles Bendire found the species quite common in the Malheur-Harney Lakes Basin (Brewer 1875). Bendire (1877) later considered it a common summer resident, generally distributed throughout the basin. They were found nesting in willows (*Salix* spp.) along streams and in isolated junipers and pine trees on the edge of the forest. He collected 25 egg sets which usually numbered 2, and rarely 3/clutch.

We know of no additional records until brief mention was made of several being seen in 1915 (refuge files). Willett (1919) saw 2 individuals near Malheur Lake on 26 June 1918 and 2 additional birds on 27 June. The species was considered fairly common in August 1918, but these could have been migrants. Willett further reported that between

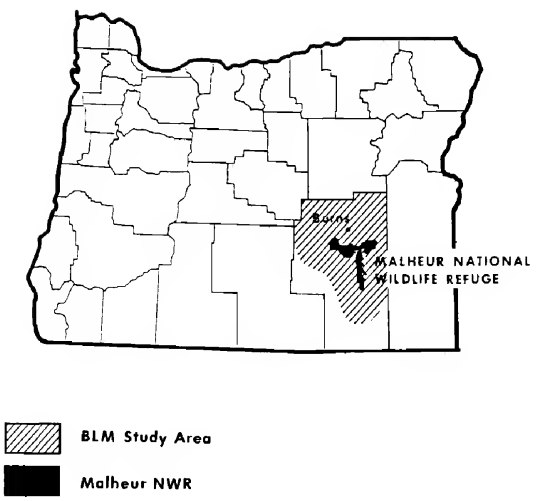

Figure 1. Location of Bureau of Land Management's nesting raptor inventory study area, in respect to Malheur National Wildlife, Oregon.

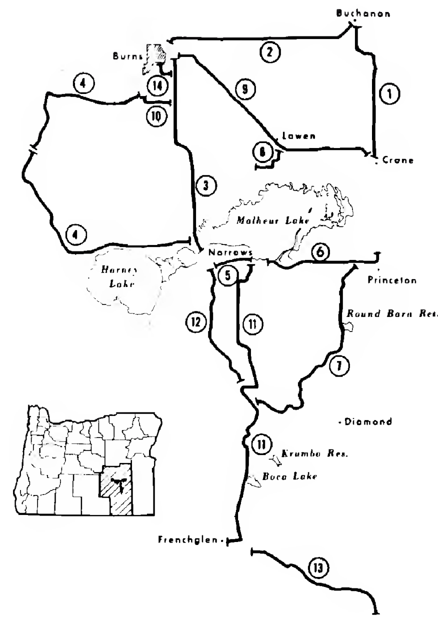

Figure 2. Locations of raptor road transects in the Malheur-Harney Lakes Basin, Oregon.

Malheur NWR and Klamath Falls, Klamath Co., Oregon the species was common along most of the route, and particularly abudant in canyons and slopes on Warner Mountains, in Lake Co. On 24 May 1920, 27 were counted as they perched on fence posts along one side of an alfalfa (*Medicago sativa*) field near Burns, Harney Co. The field contained numerous ground squirrels, and the hawks were catching rodents for food (Gabrielson 1922). Based on the lateness of the season, these birds probably represented locally nesting individuals. Prill (1922) found the species very common near Burns and as far south as Wright's Point (16 km S of Burns) from 25 May to 15 June 1921. They were commonly nesting in trees on the surrounding hills. In 1922, the Swainson's Hawk was considered the most common of the large hawks in the basin during the summer months. The species nested in junipers bordering Harney Valley where it consumed large numbers of 2 species of ground squirrels (FWS files).

Jewett (1936) considered the Swainson's Hawk as equal in numbers with the Red-tailed Hawk (*B. jamicaensis*), indicating the species had declined somewhat between 1922 and 1932. Gabrielson and Jewett (1940) reported it was once one of the most common raptorial birds in eastern Oregon, and could still be considerd a common summer resident despite a noticeable decrease in numbers during recent years. Preferred nesting habitat was reported as gnarled, twisted junipers. Forty-two egg sets collected in Oregon between 1924 through 1960, on deposit at the Western Foundation of Vertebrate Zoology, showed 64.3% in junipers, 16.6% in willows, and 19.1% in other tree species (L. Kiff, pers. comm.).

1940-1959. — Swainson's Hawks were still common in southeast Oregon in the 1940's. An estimated 150 individuals were present on Malheur NWR in the summer of 1941, from which 12 nestlings were banded. At this time some pairs were nesting in sagebrush in the northern portion of the Blitzen Valley. This nesting habitat continued to be used through the mid-1940's. From 1944 through 1947 the nesting population remained unchanged.

Table 1. Number of Swainson's(SW) and Red-tailed(RT) Hawks observed on raptor transects in the Malheur-Harney Lakes Basin, Oregon.

		TOTALS (#(KM)					
Month		1975	1977	1979	1980	1982	1983
April	SW	4 (.011)	2 (.006)	1 (.003)	0 (.000)	13 (.036)	2 (.006)
	RT	26 (.072)	21 (.058)	16 (.044)	31 (.086)	38 (.106)	56 (.156)
June	SW	2 (.006)	20 (.060)	8 (.020)	18 (.050)	4 (.011)	7 (.019)
	RT	14 (.039)	46 (.128)	29 (.081)	67 (.186)	63 (.175)	36 (.100)
August	SW	7 (.020)	16 (.040)	20 (.060)	30 (.080)	26 (.072)	23 (.064)
	RT	46 (.128)	55 (.153)	67 (.186)	96 (.267)	60 (.167)	31 (.086)

In 1947, it was still the most commonly seen raptor with an estimated 150 individuals. No information was available from 1948 through 1957, but there was no indication of change in the species' status.

In the late 1950's the population began to decline. In 1958, several pairs nested in willows on Malheur NWR. A rodent infestation occurred from May through August, but no Swainson's Hawk increase was noted on the refuge. However, neighboring valleys had larger populations of both Swainson's and Red-tailed Hawks. In 1959, a reduction in the local nesting population was reported (Refuge N.R.)

1960-1983. — In the 1960's, low populations of Swainson's Hawks persisted. The species increased by 2 pairs on the refuge in 1960, but their numbers were low compared with those of previous decades. By 1962 there were only 2 nesting pairs. Pair numbers fluctuated through the 1960's, with the highest number recorded in 1966 with 5 pairs. Four pairs were present in 1967, and for the first time in recorded history there were no nesting Swaison's Hawks on Malheur NWR in 1968. However, in 1969 and 1970, 2 pairs were present, increasing to 3 pairs in 1971. This was the last nesting record in willows, and the last until 1979 in any habitat on Malheur NWR. The 1979 nesting effort was in a juniper and unsuccessful. Eggs were incubated but did not hatch.

In the BLM study area (Fig. 1), 18 Swainson's Hawk breeding territories were located in 1980. Densities were one pair/1,465 km^2 on the BLM study area. The nearest nesting pair to Malheur NWR was 9.6 km east. Johnstone, et al. (1980) reported all 18 nests were in western juniper. Mean tree height was 5.5 m and mean nest height was 5.0 m. Nesting trees were mostly isolated, near or in stands of low structured vegetation such as crested wheatgrass (*Agropyron cristatum*), alfalfa, or cheatgrass (*Bromus tectorum*). The majority of nests located in the past 7 years has been near sagebrush removal projects. Prey remains collected at the nests indicated their major prey was Horned Larks (*Eremophila alpestris*), Western Meadowlarks (*Sturnella neglecta*), ground squirrels, various small mammals and insects (Johnstone, et al. 1980).

Swainson's Hawk numbers have varied on June raptor transects (Table 1), and consisted of single individuals or pairs. Single individuals were assumed to have a mate incubating or brooding at the time the transect was conducted. In 1975, only 2 birds were recorded, but 20 were noted in 1977. Seven were seen on the 1983 transects. Most of these birds were associated with agricultural or crested wheatgrass areas located east and west of Burns, Oregon. None was recorded in riparian habitat. Most Swainson's Hawks seen on the 1977, 1979 and 1980 transects were members of pairs whose nests had been previously located by BLM personnel during nesting raptor inventory studies.

Migrational Accounts. — Little historical information was available on Swainson's Hawk migration in southeast Oregon. Leopold (1942) observed 37 (0.58/km) in August 1941 on a single trip through the Blitzen Valley, and reported the species as the most commonly seen raptor on Malheur NWR. A total of 56 individuals was seen on 1 August and 50 on 1 September 1947 (Refuge N.R.).

Road transects conducted in April and August 1975, 1977, 1979, 1980, 1982 and 1983 (Table 1) indicated Swainson's Hawks were no longer a common species during spring and fall migration in the Malheur-Harney Lakes Basin. Before the 1960's the species was considered more common than the Red-tailed Hawk. When comparing the two from transect data, Red-tailed Hawks were more common than the Swainson's Hawk (Table 1).

DISCUSSION

Reductions in the Swainson's Hawk nesting population in southeast Oregon, Nevada and northeast California are presently unexplained. In southeast Oregon, juniper and riparian habitats are available and appear adequate for nesting sites, therefore, other factors are apparently involved. A recent increase in the Great Horned Owl (*Bubo virginianus*) in riparian habitat on Malheur NWR could be responsible for the disapperance of nesting Swainson's Hawks in willows. An active nest in 1962 was taken over by a Great Horned Owl pair in 1963. Swainson's Hawks have not nested in this area since. In 1966, there was an active hawk nest 1.6 km east of the site and it could have been the displaced pair. Newton (1979) reported Swainson's Hawks nesting close to Great Horned Owls had significantly less success than those nesting in tree clumps lacking these predators. In Washington, Fitzner (1980) reported distances between Swainson's Hawk and Great Horned Owl nests ranged from 2.2 to 3.1 km indicating less tolerance to Great Horned Owls than to other raptorial birds. Smith and Murphy (1973) also found the species nested far from Great Horned Owls (mean distance 3.54 km). Both of these studies reported a low tolerance between the two species.

Another possible factor for the species' decrease is a reduction in foraging sites within a pair's territory. Yensen (1980) reported vegetation in southwest Idaho was once a mosaic dominated by open stands of sagebrush with an understory of perennial grasses. The vegetation was severely damaged by sheep and cattle in the late 1800's and early 1900's. Added to a 14-year dry period, culminating in the severe drought of 1934, the native grass understory was virtually eliminated. A similar condition occurred in southeast Oregon. As native grasses disappeared because of overgrazing, sagebrush became the dominant plant. Accompanied with fire suppression by federal agencies, large monotypic stands of sagebrush have been perpetuated. Bechard (1980, 1982) reported hunting sites by Swainson's Hawks in Washington was not based on prey density, but more likely on vulnerability of prey to predation. With dense stands of sagebrush the vulnerability of prey for the species probably was reduced, resulting in Swainson's Hawks abandoning many regions of southeast Oregon. The 18 territories reported by Johnstone, et al. (1980) were mostly near low structured vegetation and away from dense monotypic shrubs.

Another possibility is the local nesting population is being limited either in migration or on their wintering areas. The species has been reported as having difficulty in their Argentine wintering regions where large scale use of pesticides has been used for locust control (N. Smith, pers. comm., Olrog 1967). Locust are apparently an important prey base for Swainson's Hawks in Argentina. If this agricultural activity is occurring in localized regions, the Great Basin population could be wintering in such an area. This might account for the decrease in nesting pairs in southeast Oregon, northeast California and Nevada when compared with other populations in western North America. Henny and Kaiser (1979) found low levels of DDT and its metabolites in Swainson's Hawk eggs in northeast Oregon. Low levels of DDT were also found in eggs collected in northeast California in 1982 and 1983 (R. Schlorff, pers. comm.). Therefore, it is reasonable to assume DDT is not responsible for the decline of Swainson's Hawks in the northern Great Basin, but other pesticides might be involved. Only 6 years data are available from raptor transects, but there appears to have been a decline in spring migrants (except in 1982). However, migrant counts in August have remained relatively stable since 1979 (Table 1). If the same migration corridors were used by individuals in spring (April) and fall (August), a major loss of Swainson's Hawks is occurring south of the Malheur-Harney Lakes Basin.

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Raptor Research Foundation Meeting. The 1984 annual meeting of the Raptor Research Foundation, Inc., will be held October 25-28 at Virginia Polytechnic Institute and State University, Blacksburg, Virginia. The tentative schedule is:

26-27	October	Paper and Poster Sessions
27	October	Banquet
28	October	Open

For further information, program suggestions, or space requests, contact: Dr. Jim Fraser, Department of Fish & Wildl. Sci., VPI & SU, Blacksburg, VA 24061

NESTING BIOLOGY OF BROAD-WINGED HAWKS IN WISCONSIN

Robert N. Rosenfield

Abstract — Seventy-two nestings in 56 Broad-winged Hawk (*Buteo platypterus*) nesting areas were investigated in Wisconsin from 1976 through 1981. Trembling aspen (*Populus tremuloides*) and white birch (*Betula papyrifera*) supported 51% and 29% of all nests, respectively. A reoccupancy rate of 0.60 was found for 16 nesting areas. Mean distances between nests on an intensive study area were 1.5 km (1976; n=9), 1.7 km (1980; n=9), and 1.1 km (1981; n=10). Density in 1981 on 23.7 km² was 1/2.4 km². Means of 2.4 eggs laid, 1.8 hatched, and 1.5 young fledged were found for 70 active nests. Fifty-five of 70 (79%) nests fledged young. The major factors reducing productivity occurred before hatching.

Relatively little has been published on the nesting ecology of the Broad-winged Hawk (*Buteo platypterus*). There are few productivity and density data for this common breeding raptor of North America's eastern deciduous forests. The first review of Broad-winged Hawk biology by Burns (1911) was general, though extensive. Recent studies of various aspects of Broadwing nesting ecology have reported data from relatively few nests: Rusch and Doerr (1972) 5 nests in Alberta; Fitch (1974) 3 nests in Kansas; and Matray (1974) 14 nests in New York. Keran (1978) presented habitat data from 29 nests in Minnesota and Wisconsin. Intensive studies of nest habitat by Titus and Mosher (1981), and nesting biology by Janik and Mosher (1982) are based on 24 and 36 nests, respectively, in Maryland. This paper presents data from 72 Broad-winged Hawk nests in Wisconsin from 1976 through 1981. The objectives of my study were to determine the spacing of nests, density of nesting pairs, and productivity.

Study Area and Methods

In 1976, 1980, and 1981, I intensively searched for Broadwing nests in an area approximately 1.6 km north of Merrill, Wisconsin, 45°10′ lat 89°40′W long. Here, I did not establish study area boundaries and completely search the interior in 1976 and 1980; instead, I conducted an intensive nest search and then established a boundary around the area I was able to inventory, resulting in 18.1 km² and 17.5 km², respectively (Fig. 1). In 1981 I established a 23.7 km² study area prior to nest searching (Fig. 1). I am confident that I found all Broadwing nests on the Merrill study area in 1976, 1980, and 1981 (Fig. 1).

In 1977 through 1979 I searched for nests in areas similar to known nest habitat within 10 km east, west and north of the Merrill study area; in 1977 through 1981 I revisited known nesting areas to determine reoccupancy. Nests were also found incidental to other research on the Nicolet National Forest, 120 km northeast of Merrill, and on 2 other areas, one 266 km south and another 190 km northwest of Merrill, respectively. Calling Broad-winged Hawks led me to nesting areas; fresh greenery on nests indicated recent use.

The 1981 Merrill study area was nearly level, ranging from 399 to 412 m in elevation. Its habitat included 39% upland hardwoods, 36% farmland, 10% alder (*Alnus rugosa*) thicket, 8% bog, 2.5% permanent water, 2.5% residential, 1.2% swampland, and 0.7% red pine (*Pinus resinosa*) plantation. Ground moraine soils were poorly drained, and small (2-10 m²) woodland pools of water were common throughout spring and summer. The typical upland hardwood was trembling aspen (*Populus tremuloides*) which existed in pure stands or mixed with white birch (*Betula papyrifera*) and balsalm fir (*Abies balsamea*). Black ash (*Fraxinus nigra*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*) were common in permanently wet areas.

An active nest or nesting attempt was one in which eggs were laid; an occupied nest was one in which 2 adults were present near a recently constructed nest with fresh greenery on top (Postupalsky 1974). A nesting area was that area within a radius of 250 m of a nest. A nesting area was considered reoccupied if, in subsequent years, an active or occupied nest was found within 250 m of a previously used Broad-winged Hawk nest, or if a nest was reused by Broadwings.

Mean distances between nests on the Merrill study area were determined in 1976, 1980, and 1981 in the manner reported by Reynolds and Wight (1978). Productivity was determined by climbing to each active nest once during mid-to-late incubation and again about 2 w later to record the clutch size and the number of nestlings, respectively. I returned to nests to determine fledging rates when I estimated young to be > 30 d old.

Results and Discussion

I found 70 active and 2 occupied Broad-winged Hawk nests; 28 by intensive searching, 12 by searching habitat similar to known nest habitat, 17 by revisiting nesting areas in subsequent years, and 15 as incidental finds. Broad-winged Hawks nest in a variety of hardwood tree species across their breeding range. The majority of nests in my study were supportged by trembling aspen (51%) and white birch (29%). Matray (1974) reported 86% of 14 nests in yellow birch (*Betula alleghaniensis*) in New York. In Maryland, Titus and Mosher (1981) found 79% of 24 nests in various oaks, predominantly white oak (*Quercus alba*) (50%). Burns (1911: 246) reported American chestnut (*Castanea dentata*) as the most "popular" nest tree in the northeastern United States. Keran (1978) reported 21% of 29 nests in Minnesota and Wisconsin in aspen and 41% in oak. Diameter at breast height and height of nests in trees in my study were less than those reported in other studies (Table 1).

Table 1. Comparison of diameter at breast height (DBH) of nest trees and height of Broad-winged Hawk nests ($\bar{x}$ ± S.D., (range)).

Source	N	DBH	Nest Height (M)
This study	72	31.5 ± 6.3 (21.1 - 48.8)	8.2 ± 2.7 (3.9 - 15.4)
Burns (1911)	167	-	10.1
Matray (1974)	14	54.1 ± 8.3 (42.1 - 74.2)	13.3 ± 1.4 (11.0 - 15.5)
Titus and Mosher(1981)	24	38.0 ± 9.5 (25.0 - 62.0)	13.7 ± 3.0 (9.5 - 20.6)

Twenty-nine of 56 (52%) Broad-winged Hawk nesting areas in this study contained 1 or more other stick nests. This suggests that a nest area, not just a nest tree, has some important characteristics, such as the interspersion of habitat types, that may be related to the high nesting density (see below). The importance of certain areas for nesting is further indicated by the reoccupancy rate. I revisited 16 nesting areas (including nest areas on the Merrill study area) 47 times in subsequent years and

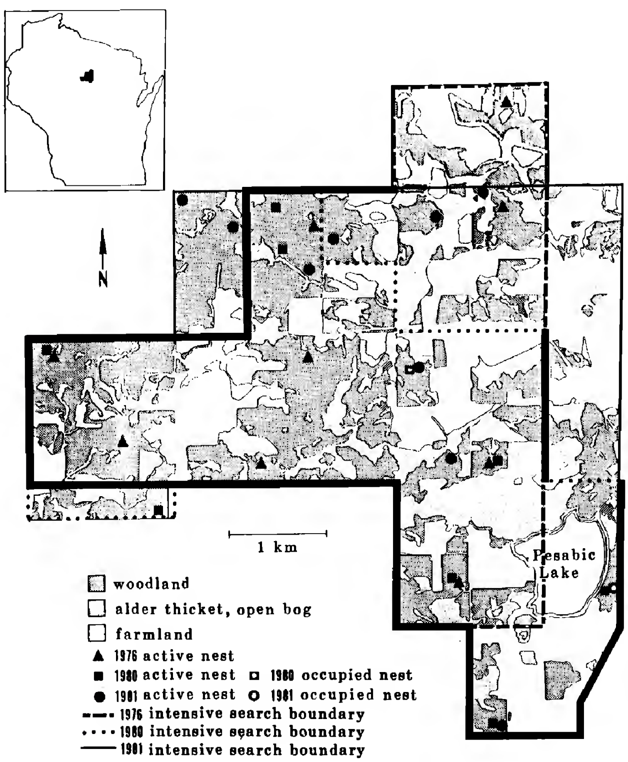

Figure 1. Distribution of Broad-winged Hawk nests on the Merrill, Wisconsin study area. Thickened line indicates where 2 or more years formed the study area boundary.

found them reoccupied on 28 occasions, resulting in a reoccupancy rate (number reoccupied/number revisited) of 0.60. Broadwings usually built a new nest in a different tree in a reoccupied nesting area. Broad-winged Hawk nests were reused on only 5 occasions; 3 the next year, 2 the second year.

Mean distances between nests on the Merrill study area were: 1976-1.5 km (range = 1.1-2.2 km, SD = 0.37 km), 1980-1.7 km (range = 0.6-3.1 km, SD = 0.72 km), and 1981-1.1 km (range = 0.5-2.4 km, SD = 0.62 km). The smaller mean distance in 1981 was due to the close spacing of the 6 most northerly nests (Fig. 1) that were in locally wet areas.

Density on the Merrill study area in 1981 was 1 pair/2.4 km^2. Variously derived densities in other studies were a maximum of 1 pair/23.3 km^2 estimated by Rusch and Doerr (1972) in Alberta, 1 pair/5.2 km^2 estimated by Burns (1911: 176) in Massachusetts, and 1 pair/2 mi^2 (this converts to 5.2 km^2 rather than 3.2 km^2 as stated) reported by Keran (1978) in Minnesota. Wisconsin density is high when compared to other studies.

I suggest that the relatively high density of nesting Broad-winged Hawks in 1981 is related to the interspersion of habitat types on the Merrill study area, which lies between extensive northern forests and an intensively farmed central region of Wisconsin. The partial conversion of forests to farmland in this area has created more upland openings and edge habitat than were originally present. Keran (1978) suggested that such openings may be important to nesting Broad-winged Hawks because they are utilized as primary hunting sites. Fuller (1979) found Broadwings in field-forest edge more than would be expected by chance when this habitat type occurred in their home ranges. Further, 5 of 6 Nicolet Forest nests were within 50 m of roadways, which perhaps served as primary hunting sites in an extensively forested area. Titus and Mosher (1981) indicated that Broad-winged Hawks nested closer to both water and forest openings than would be expected by chance. Matray (1974) stated that Broadwings seemed to prefer nesting on poorly drained sites. The importance of wet areas is suggested by the close spacing of the aforementioned 6 nests which corresponded with the occurrence of wet habitat in the Merrill study area.

Means of 2.4 eggs laid, 1.8 hatched, and 1.5 young fledged per nest attempt were found in this study (Table 2). A one-way analysis of variance revealed no significant ($P > 0.05$) differences among the yearly means, even though there was considerable variability. Janik and Mosher (1982) reported Broad-winged Hawk productivity data for a 3 y study in Maryland, but they did not report yearly means. I do not know if the annual fluctuations found in my study are common for the species or if they are a function of the relatively small number of nests analyzed each year.

Table 2. Mean number of eggs laid, hatched and young fledged per nest attempt[1].

Year	N	Eggs laid[2]	Eggs hatched	Young fledged
1976	9	2.2	1.9	1.8
1977	10	2.0	1.3	1.1
1978	14	2.3	1.9	1.7
1979	12	2.3	1.7	1.3
1980	10	2.5	2.1	1.5
1981	15	2.6	2.0	1.7
Total	70	2.4	1.8	1.5

[1]A nest attempt was one in which eggs were laid.
[2]The distribution of clutch sizes was 2 clutches of 1 egg, 43 of 2, 23 of 3, and 2 of 4.

Fifty-five of the 70 (79%) active nests fledged young. The major factors that decreased Broad-winged Hawk productivity occurred before hatching (38 eggs were lost compared to 20 young). I could not determine the cause of all egg and nestling losses, but I suspected mammalian predation of 4 eggs (2 nests) and of 6 nestlings (5 nests), and avian predation of 3 eggs (1 nest). Destruction of 2 nests by windstorms caused the loss of 2 eggs and 3 nestlings. My extended visit may have caused a female to desert another nest with 3 eggs. The incubating adult at 1 nest may have kicked 1 of 2 eggs out of the nest cup, as an ejected egg was found embedded within the nest structure. Fifteen (14 nests) of the 165 eggs laid, including 2 complete clutches, did not hatch for unknown reasons. The cause of loss of 10 eggs (6 nests) and 11 nestlings (10 nests) was unknown. Suspected predators of Broadwing nests were the Raccoon (*Procyon lotor*) and Common Crow (*Corvus brachyrhynchos*).

My study further supported the importance of both woodland openings and wet areas to Broadwing nesting habitat. Wisconsin productivity data provide some basis for understanding the population dynamics of Broad-winged Hawks. However, the number of young produced in any one year that is necessary to maintain a stable population is a factor of the age structure and mortality rates of nesting adults (Henny and White 1972). Such data do not exist for the Broad-winged Hawk. Future studies should include long-term trapping and marking of breeding adults to determine age structure and turnover rate of nesting populations.

ACKNOWLEDGMENTS

This paper is based in part on a thesis submitted to the College of Natural Resources, University of Wisconsin-Stevens Point, in partial fulfillment of the requirements for the Master of Science degree. My graduate committee, R. Anderson, M. Fuller, and F. and F. Hamerstrom, greatly improved the manuscript by their suggestions. S. Postupalsky reviewed an earlier draft. R. Burton assisted with figure preparation. I am grateful to many field assistants, particularly L. Carson, M. Gratson, C. Harris, A. Kanvik, G. Kristensen, R. Murphy, and A. Rosenfield. D. Ledger provided field headquarters. I especially thank my wife, C. Rosenfield, for both her support and encouragement throughout this study.

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Anderson Award. The 2nd annual William C. Anderson Award for the best student paper was presented at the 1983 Raptor Research Foundation meeting in St. Louis, Missouri. The winner was Mr. Jim Duncan of the MacDonald Raptor Research Center, McGill University. Jim's paper was entitled "Mate Selection in Captive Kestrels: I. Siblings vs. Strangers."

Students wishing to be considered for the 1984 ANDERSON AWARD must indicate their eligibility when submitting abstracts. Eligibility criteria were published in *Raptor Research* 16(1):30-32. Questions regarding the 1984 award should be directed to: Dr. Robert Kennedy, Director, Raptor Information Center, National Wildlife Federation, 9412 16th Street, NW, Washington, D.C. 20036.

Attention RRF Members Past and Present!! The Raptor Research Foundation, Inc., is approaching its 20th Anniversary. In honor of this memorable occasion, I am compiling a twenty-year history of the Foundation to be presented in Sacramento at the 1985 annual meeting. In addition, plans are to compose a monograph detailing the Foundation's history from beginning to present. I request the assistance of you, the membership, both past and present, in accomplishing this task. Please contact me if you have any pertinent information in your files, such as photographs, correspondence, etc., that you would be willing to loan to me. All such material will be acknowledged in publications, of course, and I will make copies of the materials for my use and return the originals immediately. If you have anything you wish to contribute, please contact me as follows: Jimmie R. Parrish, Department of Zoology, 159 WIDB, Brigham Young University, Provo, Utah 84602, USA.

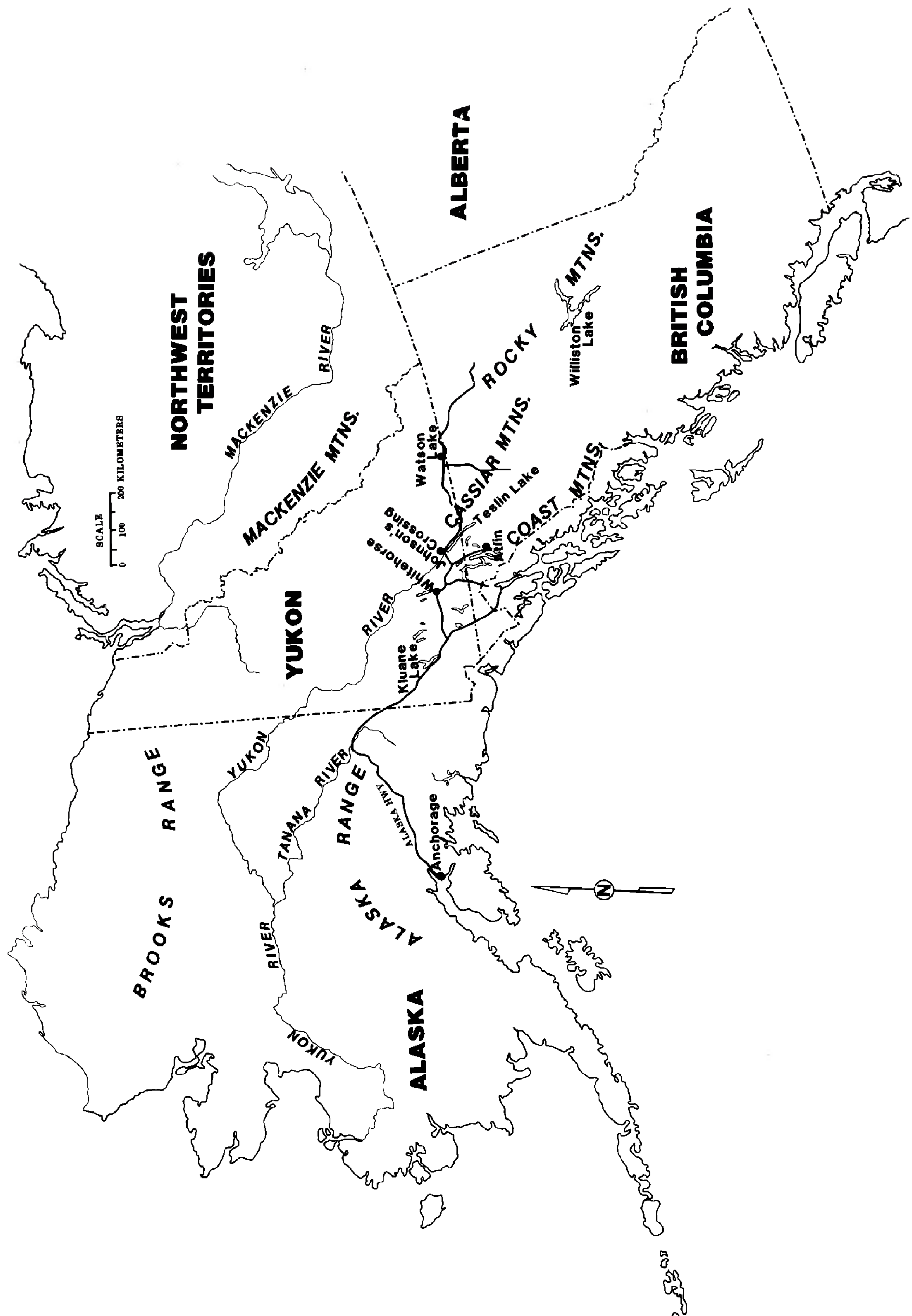

Figure 1. Map of Canadian and Alaskan observation sites visited during Spring 1982 raptor migration.

RAPTOR MIGRATION IN NORTHWESTERN CANADA AND EASTERN ALASKA, SPRING 1982

DAVID P. MINDELL AND MARGARET H. MINDELL

ABSTRACT - Searches for migrant raptors in northern British Columbia, southern Yukon Territory and eastern Alaska were made between 29 March and 29 April 1982 at locations accessible by road along 3 potential, broadfront, migratory routes. Migration activity occurred within an intermountain route, passing between the Rocky and Pelly Mountains on the east and Coast and St. Elias Mountains on the west. We saw no migrant raptors coming from a coastal route north over Chilkat or White passes, or coming from a Canadian prairie route, east of the Rocky Mountains, over the pass along the Alaska Highway in the Summit Lake vicinity. We found concentrations of migrant raptors along the Lina Range by Atlin Lake, British Columbia, and at Johnson's Crossing and in the Takhini River valley of southern Yukon Territory. Northern Harriers (*Circus cyaneus*) were most frequently seen, followed in decreasing order by Red-tailed Hawks (*Buteo jamaicensis*), Golden Eagles (*Aquila chrysaetos*), Rough-legged Hawks (*Buteo lagopus*), Bald Eagles (*Haliaeetus leucocephalus*), and Peregrine Falcons (*Falco peregrinus*). Comparison with other studies suggest that migrant buteos and Golden Eagles make greater use of an intermountain route through northwestern Canada than of a coastal route along the Gulf of Alaska, while migrant Sharp-shinned Hawks (*Accipiter striatus*) more frequently use the coastal route.

Migrating raptors seeking the most direct overland route to breeding areas in extreme northwestern North America are funneled into areas of northwestern British Columbia, southwestern Yukon Territory, southeast and southcentral Alaska. Movements of migrant raptors to and from Alaska and northwestern Canada have been little studied although tens of thousands of raptors pass through this region biannually.

The north-south oriented ranges of the Rocky, Cassiar and Coast Mountains along with the Pacific shoreline delineate 3 broadscale, potential migration routes (Fig. 1) described as follows: 1) Coastal - along the west coast of British Columbia, and southeast Alaska, then either inland over mountain passes or continuing northwest along the Alaska coast south of the Chugach Mountains into central Alaska via the Copper River drainage, Portage Pass or other overland routes; 2) Intermountain - through the intermountain trenches in northern British Columbia and southwestern Yukon Territory into the Yukon and Tanana River drainages; and 3) Canadian prairies - through Alberta and northeastern British Columbia east of the Rocky Mountains, then crossing the Rocky Mountains, and heading northwest through British Columbia and/or Yukon Territory similar to the intermountain route. These 3 principal routes, all or in part, have been described previously by West et al. (1968) as apparent routes for migrating Lapland Longspurs (*Calcarius lapponicus*).

Raptor migration is generally a broadfront passage, occurring to some degree over nearly all land regions of the temperate zone. The distribution of visible migrants, however, is not random, partly due to topographic features either discouraging or inducing travel in a particular direction. Gauthreaux (1979) has pointed out that despite the prominence of migration in avian lifestyles, routes, rates and calendars of migration are known for few species aside from waterfowl. The purpose of this study was to learn about distribution of migrant raptors moving through northwestern Canada and eastern Alaska, to locate specific areas of migrant concentration for future study, and to learn about timing of regional migration.

STUDY AREA AND METHODS

Between 29 March and 29 April 1982, 3970 km were driven between Dease Lake on Rt. 37 in British Columbia, Summit Lake on Rt. 97 in British Columbia and Anchorage, Alaska. Observations were made in 3 potential, broadscale, raptor migration routes to compare their relative use. We attempted to observe in areas physiographically conducive to concentrating migrants, such as along major rivers, lakes, southeast to northwest trending ridges, and mountain passes. Observations were made from roads or within 3 km hiking distance of roads, using binoculars or a 20X spotting scope to search for and identify migrants. Some of the most promising areas were rechecked on 2-3 non-consecutive days to reduce bias associated with varying weather conditions. Once an area was perceived to be used, we moved to another location. No attempt was made to count large numbers of birds or to determine magnitude of the migration.

Raptor migration in interior western North America occurs along a broader front (Hoffman 1981, and in press) with smaller local concentrations of birds compared to eastern North America (Heintzelman 1975) and elsewhere (Smith 1980, Christensen et al. 1982). We use the term "route" to denote a broadscale, dispersed movement, and do not suggest that lack of sightings in any area indicates complete lack of use by migrants. We attempted to spend sufficient time at different locations in each of the 3 possible routes mentioned, to enable comparison of their relative use.

The possibility of migrants departing from the general coastal route by moving northward through Lynn Canal and then into mainland areas was checked by observing at Haines (Lentnikof Cove, Flat Bay) and Chilkat and White Passes. The intermountain route was sampled by observing at numerous locations along the Alaska Highway between Watson and Kluane Lakes (Fig. 1) and along Rt. 3 to Haines, Rt. 2 to Carcross, and Rt. 7 to Atlin. The possibility of migrants crossing the Rocky Mountains along the route of the Alaska Highway was checked from lookouts in the vicinity of Muncho and Summit Lakes, British Columbia. We distinguished migrants from possible residents by behavior. Sedentary birds or birds moving south or east were not counted unless they were south of their breeding range (e.g., Rough-legged Hawks (*Buteo lagopus*)).

RESULTS AND DISCUSSION

ROUTE USE. — All migrant activity seen occurred within the intermountain route, passing between the Rocky Mountains on the east and the St. Elias and Coast Mountains on the west. No migrant raptors were seen coming from a coastal route north over Chilkat or White Passes or from east of the Rocky Mountains over the pass travelled by the Alaska Highway in the Summit Lake vicinity. Migrant Northern Harriers (*Circus cyaneus*), Red-tailed Hawks (*Buteo jamaicensis*), Rough-legged Hawks and Golden Eagles (*Aquila chrysaetos*) were seen in the intermountain route (Takhini River valley west of Whitehorse) before, during, and after observations at Summit Lake and Chilkat and White Passes (Table 1), suggesting that the lower abundance of migrants coming over the passes and at Summit Lake was not due only to timing of observations.

Migrants passing through southern Yukon Territory in mid-April were apparently approaching from northwestern and northcentral British Columbia and the intermountain route rather than from a coastal or a Canadian prairies route through northeastern British Columbia. Late April weather conditions were still severe in Chilkat and White Passes and along the route of the Alaska Highway (Rt. 97) through the Rocky Mountains with 1 to 3 m of snow cover, whereas the Takhini River valley and much of the intermountain route were more temperate with some bare ground showing by late April. This is not to imply that no migration occurs through these passes or areas with snow cover. Several groups of 3-6 Sharp-shinned Hawks (*Accipiter striatus*) were seen heading south through Chilkat Pass on 7 October 1980. Weather in these mountain passes may be generally milder during the fall migration than during the spring, and use by migrants may be correlated with the difference.

On 27 and 28 March 1982 an apparent vanguard of the Canada Goose (*Branta canadensis*) migration (over 440 individuals) was seen resting along the last unfrozen sections of the Fraser River in central British Columbia, between Lac La Hache and Quesnel. Six Red-tailed Hawks were also seen 40 to 30 km south of Quesnel on 28 March 1982. No migrant raptors or geese were observed during the subsequent 7 days spent driving north to Watson Lake and observing in the area between Watson and Teslin Lakes. On this basis, it seems unlikely that large numbers of raptors passed through northwestern British Columbia or southwestern Yukon Territory before observations began.

Table 1. Observation sites, date, and total raptor sightings for Spring 1982 migration in northwestern Canada and Eastern Alaska. (B.C. = British Columbia; Y.T. = Yukon Territory.)

Location	Dates	No. migrant raptors seen
Summit Lake, B.C.	16-18 Apr	0
Johnson's Crossing, Y.T.	1,14,15,19-21 Apr	73
Atlin Lake, B.C.	21-23 Apr	142
White Pass, B.C.	3, 24, 25 Apr.	0
Chilkat Pass, B.C.	8, 12, 13 Apr.	0
Haines area, Alaska[1]	9-12 Apr	0
Takhini River valley, Y.T.	5, 6, 13, 14, 26 Apr	53
Other[2]	5-28 Apr	46

[1]Lentnikof Cove, Flat Bay.

[2] <3 migrant raptors were seen at any one location, and all locations were within the intermountain route.

Based on physiographic features, 3 sub-routes can be distinguished within the broader intermountain route: 1) between the Rocky and Cassiar Mountains, entering Yukon Territory near Watson Lake, 2) between the Pelly and Cassiar Mountains and the St. Elias and Coast Mountains, entering Yukon Territory near Teslin, and 3) along the east slope of the Coast Mountains and Atlin or Tagish Lakes entering the Yukon River drainage near Whitehorse. Observed migrant activity was greater in sub-routes 2) and 3).

Recoveries of Alaskan banded birds show that at least some Peregrine Falcons (*Falco peregrinus*) (Ambrose et al. 1983) and Rough-legged Hawks (Kessel and Cade 1958) cross the Rocky Mountains, and many Alaskan breeding Red-tailed Hawks do so as well. Migrants cross the Rocky Mountains in many regions, however, Williston Lake west of Dawson Creek, British Columbia and the Jasper and Banff areas may be worthy of future study.

A coastal route through southeastern and south-central Alaska, along the Gulf of Alaska is used by many raptors based on observations by Islieb and Kessel (1973) and Swem (1982a, 1982b). Dates of migrant passage recorded by Swem (1982a) were such that if large numbers flew from the coastal migratory route north up Lynn Canal and over Chilkat or White Passes we would likely have seen some of them.

Specific Locations of Migrant Activity. — Within the intermountain route relatively high concentrations of migrants were found at 3 locations. On 22 April we counted 117 raptors in 6 hrs, flying north along the Lina Range on the east side of Atlin Lake, British Columbia. This included 65 Northern Harriers, 21 Golden Eagles, 18 Red-tailed Hawks, 8 *Buteo* sp., 4 Bald Eagles (*Haliaeetus leucocephalus*), and 1 Peregrine Falcon. The Lina Range rises 900 m above Atlin Lake, and most of the migrants were observed from 300 m above the range to half-way down the slope.

At Johnson's Crossing, Yukon Territory we counted 73 raptors during 15.2 total hrs of observation during portions of 5 days between 14 and 21 April. Johnson's Crossing is at the outlet of Teslin Lake, a northwest trending lake approximately 80 km northeast of Atlin Lake. In descending order of abundance the migrants were: Red-tailed Hawks, Northern Harriers, *Buteo* sp., Rough-legged Hawks and Golden and Bald Eagles.

On 13 and 14 April 23 migrants were seen during 5.5 hrs of slow driving and observation in the Takhini River valley, 10 to 50 km west of Whitehorse. The Takhini River valley receives migrants that have come northwest along Teslin Lake, Atlin Lake, and Tagish Lake (intermountain route). The Takhini River valley is broad, however, we saw raptors from observation spots on Rt. 1, 3 km east of Champagne, 2 km east of the Kusawa Lake turnoff and at the Takhini River Crossing. We saw a total of 10 migrants during fast travel through the Takhini River valley on 5 and 26 April. Migrants proceeding through the intermountain route could pass along Kluane Lake, however, our observations there were after the bulk of the Northern Harrier and *Buteo* migrations had passed. We saw only a few migrants along the Tagish River at Tagish, Yukon Territory, and the Tanana River near Tetlin Junction, Alaska.

Species Abundances. — The Northern Harrier was the most frequently seen migrant (Table 2). At each of the 3 main areas of migrant activity, either the Northern Harrier or the 2 buteos as a group were most abundant. The largest flight of Northern Harriers and Golden Eagles was seen along Atlin Lake (Lina Range), while the largest flights of Red-tailed and Rough-legged Hawks were seen at Johnson's Crossing.

Table 2. Species percentages of migrant raptors (n=314) seen in northwestern Canada and eastern Alaska 5-18 April 1982.

	Red-tailed Hawk	Rough-legged Hawk	Northern Harrier	Golden Eagle	Bald Eagle	Peregrine Falcon
% of total sightings	29.1	9.4	40.2	15.7	5.2	0.4

Comparing our study with another conducted during the spring of 1982 along the Gulf of Alaska coast at Sitkagi Beach, west of Yakutat Bay (Swem 1982a), the Northern Harrier was the most abundant species along both the intermountain route and the coastal route passing Sitkagi Beach. Sharp-shinned Hawks, however, were the second most abundant species along the coastal route (26.5% of total) while none were seen in the intermountain route. Rough-legged and Red-tailed Hawks combined accounted for only 1.8% of the total sightings along the Gulf of Alaska at Sitkagi Beach, compared to 38.5% in the intermountain route. Golden Eagles were also comparatively rare along the coastal route, comprising 0.4% of total sightings, compared to 15.7% in the intermountain route.

Greater use of the coastal route by migrant Sharp-shinned Hawks and greater use of the intermountain route by migrant buteos and Golden Eagles is supported by Swarth (1924, and 1926) who found that Sharp-shinned Hawks were "never common in the Atlin, British Columbia region, not even in the fall after southward migration had begun", and by Islieb and Kessel (1973) who described Rough-legged Hawks and Golden Eagles as rare migrants, Red-tailed Hawks as casual migrants and Sharp-shinned Hawks as fairly common migrants along the Gulf of Alaska and in the Prince William Sound region. Swarth did observe migrating Sharp-shinned Hawks at Hazelton in the Skeena River valley of westcentral British Columbia, although hawks in this area may have been headed for the coast. A tendency for Sharp-shinned Hawks to migrate in greater numbers along the Pacific coast or along the southern edge of the boreal forest might help to explain the relative scarcity of migrant Sharp-shinned Hawks in inland western North America compared to inland sites in eastern North America such as Hawk Mountain, Pennsylvania, as suggested by Hoffman (in press).

Islieb and Kessel (1973) also described Red-tailed Hawks as regular fall migrants in southcentral Alaska along the Glenn Highway between King and Sheep Mountains in late September and early October. This corresponds with fall migration observations we made along the Glenn Highway in 1980 and 1981, and with observations by Bob Dittrick (pers. comm.).

Peregrines represented 0.8% of the sightings along the Gulf of Alaska, and 0.4% in the intermountain route. Swarth (1926) also saw migrant Peregrines within the intermountain route at Tagish and Teslin Lakes. On the east side of the Rocky Mountains migrant Peregrines are consistently observed in spring passing through the Edmonton, Alberta region (Dekker 1979). The observed fall passage there is considerably less, suggesting seasonal difference in distribution of migrant Peregrines. Although no migrant Merlins (*Falco columbarius*) were seen during our study they have been seen both along the coastal route (Swem 1982a) and within the intermountain route (Swarth 1924, and 1926).

Chronology. — The first migrant Rough-legged Hawks, Red-tailed Hawks and Golden Eagles were all seen on 5 April in 1982. The first Northern Harriers were not seen until 14 April. Similarity in timing of migration for Rough-legged and Red-tailed Hawks is reflected in similar breeding chronologies in portions of Alaska (Gabrielson and Lincoln 1959, Mindell 1983).

Although the present study was not designed to determine timing of peak migration, the main migration of buteos in the intermountain route through southwestern Yukon Territory and northwestern British Columbia appeared to be over by 25 April, while some Northern Harriers were still passing through. This corresponds with average laying dates over a 4-yr period of 17 May for Rough-legged Hawks and 16 May for Red-tailed Hawks along the Kuskokwim River in western Alaska (Mindell 1983). On 23 April 1982 we observed a Red-tailed Hawk nest building at Tarfu Lake near the northern end of Atlin Lake. Swem (1982a) found the peak abundance of migrating raptors passing Sitkagi Beach near Yakutat Bay to be on 28 April, with stragglers of 7 species going by as late as 8 May.

ACKNOWLEDGEMENTS

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Position Available — NATURALIST/STAFF BIOLOGIST. Hawk Mountain Sanctuary Association seeks a naturalist/staff biologist for a two-year position beginning in August 1984. Responsible for all field studies, including fall raptor migraton count. Will also participate as resource person in education program. Excellent opportunity to initiate new studies and analyze migration statistics. Computer system available. Minimum qualifications are M.S. in biology or related field, experience in conducting field studies and data analysis/write-up, experience with raptor identification, and ability and interest in working with volunteers and general public. Computer experience strongly preferred. Salary plus housing on grounds. APPLY TO STANLEY E. SENNER, EXECUTIVE DIRECTOR, HAWK MOUNTAIN SANCTUARY ASSOCIATION, RT. 2, KEMPTON, PA 19529.

Hawk Mountain Research Awards. The Hawk Mountain Sanctuary Association is accepting applications for its eighth annual award for raptor research. To apply for the $500 award, students should submit a description of their research program, a curriculum vita, and 2 letters of recommendation by 30 September 1984, to James J. Brett, Curator, Hawk Mountain Sanctuary, Rt. 2, Kempton, Pennsylvania 19529. The Association's Board of Directors will make a final decision late in 1984. Only students enrolled in a degree-granting institution are eligible. Both undergraduate and graduate students are invited to apply. The award will be granted on the basis of a project's potential to improve understanding of raptor biology and its ultimate relevance to conservation of North American raptor populations.

THE EFFECT OF MINING AND BLASTING ON BREEDING PRAIRIE FALCON (*Falco mexicanus*) OCCUPANCY IN THE CABALLO MOUNTAINS, NEW MEXICO

James C. Bednarz

Abstract - I surveyed 3 small isolated mountain ranges in southcentral New Mexico for the presence of breeding Prairie Falcons (*Falco mexicanus*). Of these, the Caballo Mountains were intensively impacted by mining and blasting activity, while the other 2 were essentially undisturbed. No falcons were found in the disturbed mountain range, but a total of 8 nests were documented in the 2 control ranges. The 3 areas were extremely similar in all respects except for the number of mining claims.

Almost no published information is available concerning the impacts of mining and blasting on birds of prey. The limited data available are restricted to observation of short-term impacts on actively nesting raptors (Stahlecker and Alldredge 1976). Several works (Allen 1979, Call 1979, Becker and Ball 1981) contain speculation about the impending impacts of mining operations on raptors and offer suggestions to minimize potentially adverse effects. Follow-up or controlled experimental studies of such impacts are virtually nonexistent.

Herein I report the numbers of breeding Prairie Falcons observed during a survey of 3 small and very similar mountain ranges in southcentral New Mexico. One of these ranges, the Caballo Mountains, has been intensively impacted by mining operations and associated human intrusions for several years. The other 2, the Fra Cristobal and Florida mountains, have minimal or no disturbance from mining. If mining and the associated blasting has no influence on Prairie Falcon nest occupancy, I would expect the numbers of breeding falcons at all 3 study areas to be similar. The habitat and number of cliffs at all 3 mountain ranges seems comparable.

Study Areas and Methods

I surveyed the Fra Cristobal Mountains on 15-18 April and 19-23 May 1980, the Florida Mountains on 21-25 April 1980, and the Caballo Mountains on 5-9 May 1980. These ranges were searched for raptors as part of a larger statewide survey with emphasis on endangered raptors on lands administered by the Bureau of Land Management (BLM). These 3 ranges are isolated, but located in relatively close proximity (Fig. 1). The climate of all 3 ranges is similar; all are extremely dry with summer daytime temp often exceeding 38° C and winter temp commonly dropping below 0° C at night. The vegetation in all 3 study areas can be characterized as creosote bush (*Larrea tridentata*) dominated shrubland on the lower slopes grading into a sparse juniper-oak (*Juniperus* spp.; *Quercus* spp.) woodland on the summits and upper, north-facing slopes (Table 1). Elements of Chihuahuan desert vegetation (e.g. *Prosopis glandulosa, Yucca* spp., *Opuntia* spp.) are more common in the Florida Mountains. Suitable cliff habitat, elevation and topographic relief above basins are comparable for all 3 study areas (Table 1). Area of suitable cliff habitat (Table 1) includes only that contiguous mountain habitat that contains cliffs potentially usable as nest sites. Foothill habitats without cliffs surrounding mountain ranges were not included in this area measurement.

Geologically, the Fra Cristobal and the Caballo mountains are nearly identical, consisting primarily of marine sedimentary rock resulting from an uplift along the Rio Grande Rift (Kelly and Silver 1952). The Florida Mountains differ in this respect as they are of a rhyolitic formation.

Field surveys in all 3 areas emphasized the most prominent cliffs, which in my experience are preferred by Prairie Falcons for nest sites. I have found that cliffs < 50 m in height are generally used only in New Mexico when larger cliffs are not available. During this study I examined numerous smaller cliffs (< 50 m in height) but none contained active Prairie Falcon nests. Surveys were accomplished by climbing to an observation point that allowed observation of 1 or more large cliffs (> 50 m of vertical or near vertical rock). I studied cliffs for falcon-like excrement ("whitewash") with binoculars and spotting scope and watched for falcon activity for periods of several hours as outlined by Bond et al. (1977) and Call (1978). Cliff observations were made in the early morning or late afternoon. After cliffs were watched for at least 2 h without success, I approached from below and attempted to disturb (by shouting and clapping hands) any previously unobserved raptor. Observations were discontinued at cliff sites when nests of the Golden Eagle (*Aquila chrysaetos*) or Prairie Falcon were located. Field examinations in all areas were conducted when falcons were expected to be incubating or possibly tending small young.

Accessibility of mountain ranges differed considerably. The Caballo range had numerous roads on talus slopes providing easy access to excellent observation perches close to prominent cliffs. On the other hand, the Fra Cristobal range was extremely remote and almost no roads approach the foothills. Although I spent nearly twice as many field days in this area, most of the additional time was used in travel. Access roads circled around the Florida Mountains, but generally stopped at the base of the talus. Search and observation effort at all 3 ranges was comparable (Table 2).

Results and Discussion

I located 5 active Prairie Falcon nests in the Florida range and 3 active sites in the Fra Cristobal range (Table 2). No nests or large falcons were observed in the Caballo Mountains. I also found 2 Golden Eagle nests in the Fra Cristobal range. In all observable physical and ecological characteristics, except for the intensity of mining, the 3 mountain

Table 1. Characteristics of 3 mountain study areas in southcentral New Mexico.

	Fra Cristobal Mountains	Caballo Mountains	Florida Mountains
Approx. area of suitable cliff habitat (km^2)	36	26	34
Maximum elevation (m)	2083	2301	2270
Elevation relief above basin (m)	730	1000	915
Primary rock type	marine sedimentary	marine sedimentary	rhyolite
Dominant vegetation community on slopes	creosote shrubland	creosote shrubland	creosote-mesquite shrubland
Dominant vegetation community at summit	juniper-oak woodland	juniper-oak woodland	juniper-oak woodland

ranges appeared to be extremely similar (Tables 1 and 2).

The area I surveyed (26 km^2) in the Caballo Mountains contained 125 active mining claims (mining claim records dt 21 June 1980, BLM State Office, Santa Fe, New Mexico). I witnessed blasting during 1 of my 5 field survey days in this area. Numerous shallow shafts were blasted into rock walls and talus slopes throughout the range. These blast shafts were concentrated at or just above the base of both large and small cliffs examined. In addition, several ladders were bolted to the vertical

Table 2. Results of field survey for Prairie Falcon nests and active mining claims in 3 mountain study areas in southcentral New Mexico.

	Fra Cristobal Mountains	Caballo Mountains	Florida Mountains
Field days	9	5	5
Cliff observation (time h)	25.9	25.0	25.0
# of major cliffs examined (>50 m in height)	10	8	9
# of major cliffs not examined (>50 m in height)	3	3	4
# nests located	3	0	5
Mining claims recorded at BLM office	0	125	29
Mining activity observed	none	intense	none

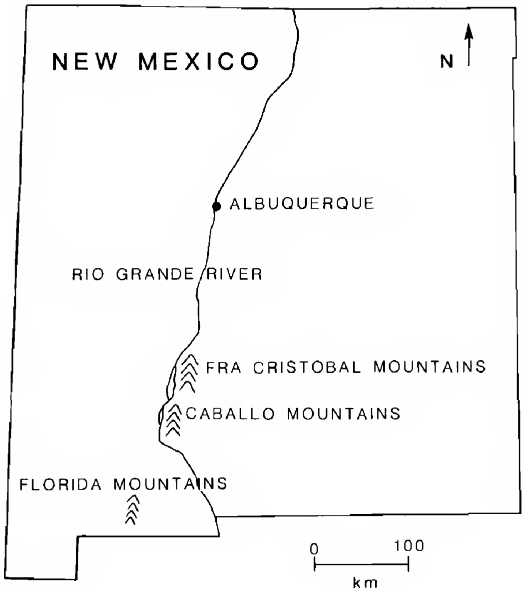

Fig. 1. Location of 3 mountain tudy areas in southcentral New Mexico.

rock walls and 2 compressors were parked high on the talus slopes adjacent to cliffs.

In the Florida Mountains, with 29 mining claims in the area surveyed (34 km^2), I observed no evidence of active mining. I did note 1 probable mining road leading up the talus slope on the north side of the mountain range. No evidence of mining activity was observed in the Fra Cristobal range.

The absence of nesting Prairie Falcons from the Caballo range was an unexpected finding. Prominent cliffs in the 2 control study areas provided habitat for 8 pairs of breeding falcons. Evidence of mining activity and related human disturbance was obvious in the Caballo Mountains, but minimal in the 2 control ranges.

Breeding falcons may have occurred in the Caballo Mountains in 1980, but if so, they must have occupied the smaller, less preferred cliffs. Given that I did not observe any Prairie Falcons, during the field survey, I suspect that few, if any, breeding falcons were present. No historical data on raptor breeding populations are available for any of the 3 ranges surveyed.

A possible alternative explanation is that low numbers of available prey made the Caballo range unsuitable as falcon breeding habitat in 1980. I feel, however, this is unlikely because the Fra Cristobal Range 30 km to the north and the Florida range 90 km to the south provided enough prey to support at least 8 pairs. The vegetative cover in the vicinity of all ranges was extremely similar in all appearances. An absence of Prairie Falcons from the Caballo Mountains could only be caused by an extreme depression in prey populations in a very localized area around these mountains, which seems highly improbable.

The Florida Mountains were used by almost twice as many falcon pairs (5 vs 3) as the Fra Cristobal Mountains. This difference may be due to the dispersion of cliffs in the respective ranges. Prominent cliffs in the Florida range were uniformly distributed along the west face, whereas in the Fra Cristobal range, cliffs were aggregated in 2 relatively small parts of the range (1 aggregation in the north portion and the other in the south). The uniform cliff dispersion probably enables more falcons to use a small mountain range without intruding into defended areas around neighboring eyries. The cliffs in the Caballo range are distributed in a manner similar to that found in the Florida Mountains. Therefore, I would expect to find between 3-5 Prairie Falcon nests if the Caballo Mountains were undisturbed.

All raptors have individual differences in the amount of disturbance that will be endured. I am aware of 1 case in Wyoming where a pair of Prairie Falcons tolerated intensive coal mining activity including blasting, heavy equipment operation, and settling pond construction within 75 m of the nest (S. Platt, pers. comm.). Falcons returned to the same general area for 3 consecutive years (1981-1983) following the disturbance. These birds were not successful in producing young in any of the years monitored, but adverse weather conditions may have been a factor (S. Platt, pers. comm.). In this case the primary disturbance was limited to 1 breeding season and was apparently of similar intensity throughout the disturbance period. Tolerant falcons may more readily habituate to a steady, predictable intensity of disturbance. In contrast, mining and blasting activity in the impacted range surveyed during this study was probably of a highly variable and unpredictable nature.

Blasting and mining operations in the Caballo Mountains are primarily the endeavaors of individual prospectors or small part-time mining partnerships. One larger corporation was mining barite at the time of my survey, but this mining was in the foothills >3 km from the area of suitable nesting cliffs. Since the climate in this area is relatively mild and there are no restrictons on blasting, I assume that all active claims are worked periodically throughout the year. All mining in the survey area seemed to be on a part-time basis. Placer gold was probably the principle mineral that was being extracted. Also, much of the mining activity is suspected to be treasure hunting in search of legendary "Spanish gold" thought to be hidden in the Caballo Mountains (T. Custer, BLM Geologist, White Sands Resource Area; pers. comm.). Treasure hunters may pursue their hobby under the facade of a mining claim which allows them to legally blast natural cliff faces. The combination of mining and treasure hunting has resulted in an extremely high intensity of blasting in the Caballo Mountains.

In conclusion, I believe the data presented here suggest that there is a difference in Prairie Falcon nest occupancy between the Caballo Mountains and the 2 control ranges most likely due to blasting and mining or associated human activities. To my knowledge, no study has examined the long-term effects of mining or blasting on occupancy of raptor nest sites, but short-term impacts have been documented (Stahlecker and Alldredge 1976). Ellis (1981), based on a 2 y study of simulated sonic boom noise, implied that both adverse short-term and long-term impacts of such activities were probably negligible on nesting raptors. My results indicate that this conclusion cannot be extended to more intensive blasting and mining activities, and I urge further observation, and particularly, controlled experimental studies to address the long-term impacts of such disturbances on breeding raptors.

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RESULTS OF A HELICOPTER SURVEY OF CLIFF NESTING RAPTORS IN A DEEP CANYON IN SOUTHERN IDAHO

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Abstract - In 1980 a helicopter survey of cliff nesting raptors was conducted along Salmon Falls Creek, a deep canyon in southern Idaho. The most numerous species recorded was the Red-tailed Hawk (*Buteo jamaicensis*) followed by the Golden Eagle (*Aquila chrysaetos*), Prairie Falcon (*Falco mexicanus*), and Common Raven (*Corvus corax*). Great Horned Owls (*Bubo virginianus*), Barn Owls (*Tyto alba*), and Turkey Vultures (*Cathartes aura*) were recorded when they flushed from cliff faces. Numbers of Prairie Falcon nests and Barn Owls flushed may have been related to land use practices near the canyon. Inter-nest distances, productivity, nest exposure and the behavioral response of nesting adults are presented for the 4 principle nesting raptors. A comparison of the results of a simultaneous boat survey revealed that the helicopter survey was faster and more accurate in determining total active and inactive nests.

Nesting densities of raptors in the intermountain west have been determined for several locations (Platt 1971, Smith and Murphy 1973, Howard et al. 1976, Seibert et al. 1976, Thurow et al. 1980). However, except in the Snake River Birds of Prey Area (BPSA), few nesting surveys have been conducted in deep canyons in this region (USDI 1979a). The data reported herein were gathered in 1980 during a helicopter survey of Salmon Falls Creek, a deep canyon in southern Idaho.

Study Area and Methods

The northern part of Salmon Falls Creek flows for approximately 103 km from the Nevada border north to its confluence with the Snake River in Idaho. The creek is small with a mean daily flow in water-year 1980 of 4.59 m^3/sec (provisional information from the U.S. Geological Survey, Boise, Idaho). The area around the creek is cool desert (Odum 1971) dominated by shrubs where native vegetation remains. Native habitat has largely been replaced by introduced grass seedings (primarily *Agropyron cristatum*) or agriculture over large portions of the study area.

The study area was divided into 4 segments based on vegetation and physiographic features, and distances (creek-km) were measured beginning at the Nevada border. The southernmost segment (1) is characterized by a meandering stream and a 20 km long reservoir contained within a relatively shallow (50 ± 11 m) cliff-lined boundary. It is surrounded by *Artemesia arbuscula*/grass seedings. The Salmon Falls Creek Dam marks the northern end of segment 1. Beginning at the dam, the creek flows through a deep (145 ± 26 m) gorge to creek-km 62 (segment 2) and is surrounded predominantly by *Artemesia tridentata*/grass seedings to at least 3.5 km away from its rim. In the succeeding segment (3) the vegetation bordering the east side of the creek is agriculture, while the west side is covered with *A. tridentata*/grass seedings. The final segment (4) begins at creek-km 81 and is bordered on the east predominantly by agriculture and on the west by a mixture of *A. tridentata*/grass seedings and agriculture.

In 1980 from 28-30 May and on 5 June we flew in a Hiller 12E helicopter for about 16 h inventorying cliff nesting raptors in the gorge. Nesting data were collected on all raptor species except American Kestrels (*Falco sparverius*). Nest location, status (an active nest was one where adults or young were present or which obviously had recently fledged young), estimated exposure, and the behavior of adults toward the helicopter were recorded. To minimize flight time and disturbance to raptors, nest parameters were not recorded for every inactive nest, and we did not tarry at active nest sites if we were unable to count nestlings immediately.

Because cavity nests are difficult to find, we did not attempt to determine nest sites of Barn Owls, Great Horned Owls, or Turkey Vultures, but did record them when we flushed these birds from cliffs. Nests of Prairie Falcons were recorded when adults were flushed near a pothole or ledge (usually with white-wash beneath it), when young were observed, or when adult(s) defended against the helicopter.

Nest site characteristics and distances between nests were measured on topographic maps, and nest elevations were determined on maps at a point on the canyon rim above the nest. It should be noted that when 2 nests were close together and neither was close to another, the effect on our data was to double the inter-nest distance in calculation of the mean. Because we recorded nest exposure in 16 directions our sample size was too small for statistical analysis. Therefore, we lumped this information into 4 general directions to increase sample size.

Gross vegetational patterns were determined by placing a grid of 144 randomly selected spots (after Marcum and Loftsgaarden 1980) on aerial photographs of the study area in each major vegetation type. The percents of spots falling on: 1) agriculture, 2) *A tridentata*/grass seeding, 3) *A. arbuscula*/grass seeding, and 4) other (roads, canyon, water) were then calculated. The grid used to select the 144 random spots covered a square area (approximately 92.16 km^2), the corners of which (farthest random point possible) were about 6.8 km from the center of the canyon.

Results and Discussion

Nesting Density. — The most numerous nesting raptors in the canyon were Red-tailed Hawks, Golden Eagles, Prairie Falcons, and Common Ravens (Table 1). A comparison with the BPSA reveals that Salmon Falls Creek is an area of lower raptor density. The diversity of nesting raptors is also lower since no Ferruginous Hawks (*Buteo regalis*) were found nesting on cliffs in Salmon Falls Creek (Table 2). The density of nesting raptors in Salmon Falls Creek is, however, larger than reported for the Rio Grande River Gorge (Ponton 1980).

Table 1. Distribution of Raptor Nests/km (N), Raptors Flushed/km (F) and Vegetational Coverage in Salmon Falls Creek, Idaho.

								Estimated Vegetational Cover			
Segment	Golden Eagle (N)	Prairie Falcon(N)	Red-Tailed Hawk(N)	Common Raven(N)	Great-Horned Owl(F)	Barn Owl(F)	Turkey Vulture(F)	Agri-culture	*Artemesia tridentata/* seedings	*Artemesia arbuscula/* seedings	Other
1	0.13	0.7*	0.13	0.13	0.10	0.00*	0.03	0%	0%	88%	12%
2	0.28	0.27*	0.15	0.12	0.09	0.00*	0.00	0%	92%	0%	8%
3	0.21	0.31*	0.31	0.16	0.21	0.16*	0.00	29%	61%	0%	10%
4	0.10	0.05*	0.33	0.05	0.14	0.19*	0.00	70%	21%	0%	9%
Total	0.18	0.17	0.21	0.12	0.13	0.07	0.01				
Total Observations:											
	19	18	22	12	13	7	1				

*Statistical significance ($P < 0.05$), X^2 test.

There were more active eagle nests in the parts of the canyon bordered by *A. tridentata*/grass seedings, but more Red-tailed Hawk nests in the part of the canyon bordered by agricultural lands, although neither were significantly higher ($P > 0.05$). An important prey of Golden Eagles near our study area is the Black-tailed Jack Rabbit (*Lepus californicus*) (Seibert et al. 1976, USDI 1979a), a lagomorph that is dependent upon native sagebrush communities (USDI 1979a) like those in segments 2 and 3. Red-tailed Hawks, on the other hand, are a more diverse feeder and may be better able to utilize areas of the canyon bordered by agriculture.

There was a significant difference in the number of Prairie Falcon nests and Barn Owls flushed in different segments of the creek. Prairie Falcons were noted more frequently in areas bordered by *A tridentata*/grass seedings than in parts bordered by *A. arbuscula*/grass seedings or agriculture. Barn Owls on the other hand, were flushed from the canyon walls only in segments bordered by agricultural lands. These results may reflect a response to some environmental factor, such as climate, since segment 1 is higher and cooler than segment 4. However, Prairie Falcons feed on small mammals which can be adversely affected by agriculture (USDI 1979a), while Barn Owls may prefer nest sites near agricultural lands (USDI 1979b). There was no significant difference in the numbers of Great Horned Owls and Turkey Vultures flushed or Common Raven nests and vacant stick nests seen in different segments of the canyon.

Inter-nest distances. — Distances between con-

Table 2. A Comparison of Nesting Density (Nests/km) of Selected Raptors and Total Raptor Diversity Among 3 River Gorges in the western United States.

	Salmon Falls Creek Idaho	Snake River Birds of Prey Study Area Idaho	Rio Grande Gorge Colorado and New Mexico
Golden Eagle	0.18	0.19	0.04
Prairie Falcon	0.17	1.32	0.10
Red-tailed Hawk	0.21	0.37	0.18
Common Raven	0.12	0.76	0.12
Total	0.68	2.64	0.44
# of species found	9	10	5

Table 3. Straight-Line Inter-nest Distances in Km of Adjacent Conspecific Raptor Nests in Salmon Falls Creek, Idaho, and Average Inter-nest Distances in Km for Adjacent Conspecifics in the Snake River Birds of Prey Study Area Over 8 years (After USDI 1979a).

	Salmon Falls Creek $\bar{x}$ ± S.D. (min.)	BPSA Inter-nest distance (smallest min.)
Golden Eagle	4.39 ± 2.3(1.56)	3.46(0.97)
Prairie Falcon	4.13 ± 3.7(0.58)	0.65(0.09)
Red-tailed Hawk	3.91 ± 3.0(0.32)	2.08(0.35)
Common Raven	7.48 ± 7.3(0.10)	Not recorded

specific nests were variable (Table 3). Mean and min. inter-nest distances, especially for Prairie Falcons, are larger than observed in the BPSA and reflect the difference in raptor densities of the 2 areas (USDI 1979a). It should be noted that because the Snake River Canyon is comparatively wide, territorial spacing of raptors along the canyon is probably minimized.

The greatest mean conspecific inter-nest distance in our study area was among Common Raven nests. Ravens also showed the smallest min. nesting distance (0.1/km) of any conspecific nesting pair, perhaps reflecting weak intraspecific territoriality in ravens as noted by Knight and Call (1980). Common Ravens also nested close to Red-tailed Hawks and Prairie Falcons (Table 4). Close nesting of ravens to raptors has been noted elsewhere, hypothesizing a commensal relationship (Knight and Call 1980). Golden Eagles displayed the greatest $\bar{x}$ distances to their nearest neighbors in Salmon Falls Creek.

Productivity. — We recorded the number of young (most were late nestlings) in nests of 2 species. The mean number of young in 16 Golden Eagle nests was 1.94 ∓ 0.68 (range 1-3) which is comparable to the mean number of young fledged per successful nesting attempt (1.62) of Golden Eagles in the BPSA and comparison area (USDI 1979a). We observed a mean of 2.79 ∓ 0.79 (range 2-4) young for 19 Red-tailed Hawk nests. A similar figure (# of young fledged/successful nesting attempt = 2.70) has been noted in the BPSA (USDI 1979a).

Nest Exposure. — Nest exposures for all active and many vacant stick nests are contained in Table 5. The 2 rows of data resulted when we arbitrarily lumped the observed 16 exposures into quadrants which correspond nearly to NW, NE, SE, SW and then rotated the boundaries of our quadrants 45° so that the easterly and northeasterly exposures were not divided.

In the first treatment of the data, nests were oriented significantly more to the quadrant bet-

Table 4. Inter-nest Distances ($\bar{x}$ km + S.D.) of nearest neighboring raptor nests in Salmon Falls Creek, Idaho.

Species:	Golden Eagle	Red-tailed Hawk	Prairie Falcon	Common Raven
Nearest Neighbors:				
Golden Eagle	0	1.46 ± 0.80 N = 4	1.06 ± 0.54 N = 5	1.68 ± 0.73 N = 4
Prairie Falcon	0.75 ± 0.17 N = 7	0.73 ± 0.51 N = 6	0.73 ± 0.25 N = 2	0.35 N = 1
Red Tailed Hawk	1.53 ± 0.77 N = 8	0.84 ± 0.45 N = 6	0.75 ± 0.55 N = 8	0.58 ± 0.32 N = 5
Common Raven	0.18 ± 0.63 N = 4	0.48 ± 0.32 N = 6	0.75 ± 0.38 N = 3	0.10 N = 2

Table 5. Exposures of Active and Inactive Stick Nests in 4 Segments of Salmon Falls Creek as Determined by 2 arbitrary analyses.

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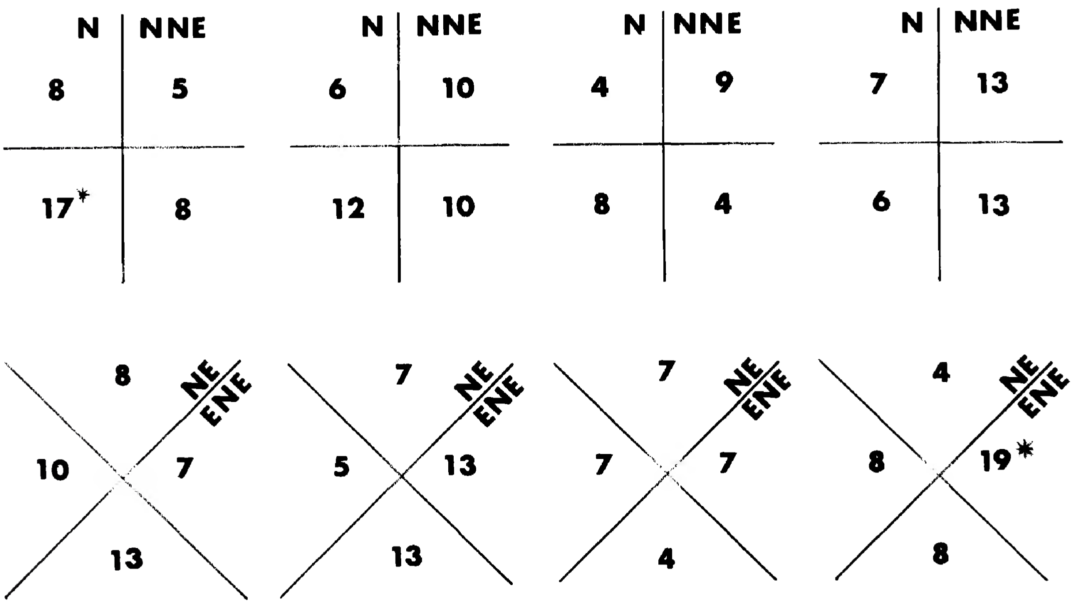
Segment 1 | Segment 2 | Segment 3 | Segment 4



*Statistically significant (P— 0.05), Chi-square test.

ween south and west-northwest in segment 1. Therefore, it appears that the Red-tailed Hawks and Golden Eagles, which built most of these nests, oriented them in a southwesterly direction. When the quadrant boundaries were rotated, a significant number of nests in segment 4, the lowest part of the canyon (elevations in segment 4 are about 500 m lower than in segment 1) are oriented nearly to the east. This may indicate that nest exposure and elevation (and thus temp) are related in Salmon Falls Creek. Seibert et al. (1976) found that Golden Eagles in northern Nevada avoided building nests with a northern exposure in a significant number of cases. Similarly, Mosher and White (1976) have shown that exposure of Golden Eagle nests at higher elevations, or in more northerly latitudes, are exposed to the south, while the reverse is true for nests at lower elevations, or in southerly latitudes.

Behavioral Response to the Helicopter. — Behavioral responses were observed at 29 Golden Eagle, Red-tailed Hawk, and Prairie Falcon nests. No adults were seen at the remaining 30 active nests.

We observed Golden Eagles near active nest sites on 6 occasions, always perching almost motionless while watching the helicopter pass-by. Page and Seibert (1973) have reported similar behavior in nesting Golden Eagles. Prairie Falcons, by contrast, flew about the helicopter calling 9 times (we could see their mouths open and close) or on 6 occasions flushed from the cliff and flew away. Once we observed Prairie Falcons near a nest diving on a Black-billed Magpie (*Pica pica*) perched well away from the cliff. This activity may have been redirected behavior (Wallace 1979) induced by our presence. Red-tailed Hawks exhibited the greatest variability in their responses to the helicopter.

Adults either defended by circling and calling (once), perched near the nest and watched the helicopter (on 4 occasions) or sat tightly on the nest (on 3 occasions). The latter response may have occurred due to adults still brooding young, since Carrier and Melquist (1976) observed a similar response to helicopters by incubating Osprey (*Pandion haliaetus*). Lee (1980) found that most raptors which were perched or nesting on transmission towers were tolerant of a helicopter used in nest surveys, although some Red-tailed Hawks tried to attack the helicopter as it approached their nest site. He also noted that birds which were on nests containing eggs or young remained on the nest when the helicopter flew past.

The Helicopter Survey and a Boat Survey Compared. — Two other biologists surveyed Salmon Falls Creek Reservoir by boat (Alan Sands and Sam Mattise, pers. comm.) while we surveyed the reservoir by helicopter. In addition to being a faster technique, other advantages of the helicopter in raptor surveys are reflected in comparison of survey results. We observed 40 active and inactive raptor nests from the helicopter, while from the boat only 31 were noted. Five different locations were thought to be possible Prairie Falcon nests by the boat survey team because of the presence of white-wash. From the helicopter these were found to be either perches or stick nests not visible from the boat due to the low angle of observation. The same 3 Red-tailed Hawk nests and 3 Golden Eagle nests were found by both survey techniques, but the boat surveyors mistook an alternate nest site for the actual Golden Eagle nest. Four raven nests were found by the boat survey while 3 were located from the helicopter. Both survey techniques produced 1 active Prairie Falcon nest, although they were at 2 different locations, illustrating the difficulty in detecting active cavity nests from the air. The greatest disparity in the results of the 2 techniques is that only 15 of 30 vacant stick nests observed from the helicopter were found by the boat survey team. Three of the stick nests recorded on the boat survey were not found from the air, but 11 recorded from the helicopter were not found by boat.

The angle of observation is the most important factor in differences between the 2 techniques. However, since the boat survey took longer, more time was allowed to see and hear nesting raptors, so that the same number of active stick nests and an additional cavity nest was found by the boat survey team.

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USE OF INTRODUCED PERCHES BY RAPTORS: EXPERIMENTAL RESULTS AND MANAGEMENT IMPLICATIONS

Steven E. Reinert

Abstract - Fourteen dead trees and 9 man-made perches were placed in the Sachuest Point National Wildlife Refuge, Rhode Island between 1977 and 1979 for use by the open country raptor community that inhabits the area during fall and winter. On 120 days during fall and winter 1978-79 and 1979-1980 raptors were observed on the introduced perches 525 times. American Kestrels (*Falco sparverius*), Short-eared Owls (*Asio flammeus*) and Northern Harriers (*Circus cyaneus*) in that order were the most frequent users. In all, 10 raptor species used the dead trees and 4 species used man-made perches. Kestrels displayed a preference for trees over constructed perches in 1979-80, but not in 1978-79. Kestrels used the perches for hunting, resting and prey consumption, but other raptors used them mostly for resting. These results suggest that introduced perches could play an important role in raptor conservation efforts.

Elevated perches are a habitat requirement of most birds of prey for hunting, resting and feeding (Brown and Amadon 1968, Brown 1976). The importance of perches has been documented by several investigators who noted the activity of raptors when first seen (Schnell 1968, Craighead and Craighead 1969, Marion and Ryder 1975, Bildstein 1978). The Red-shouldered Hawk (*Buteo lineatus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*Buteo lagopus*), Golden Eagle (*Aquila chrysaetos*) and American Kestrel (*Falco sparverius*) were perched during 50% or more of the observations of 1 or more of these authors. The importance of perches as a hunting substrate has been shown most clearly for American Kestrels. Several authors (Sparrowe 1972, Collopy 1973, Cruz 1976, Bildstein 1978) have found that kestrel attacks on prey were initiated from a perch in 71% or more of the attempts, and that the attacks initiated from a perch were more successful than attacks initiated from flight.

The erection of man-made perches, especially utility-line towers, has served as a passive raptor management tool by opening up millions of acres of habitat to hunting from stationary perches (Olendorff et al. 1980). For example, in Colorado, Stahlecker (1978) documented a concentration of raptors in the area immediately surrounding a newly constructed transmission line. Such findings have led to the introduction of elevated perches in suitable hunting range where tall perches are lacking (Christensen 1972, Snow 1974, White 1974, Steenhof 1977, Stumpf 1977, Hall et al. 1981). Herein I report the use of 2 types of raptor perches introduced into the Sachuest Point National Wildlife Refuge on the Rhode Island coastline.

Study Area and Methods

Sachuest Point is an 86 ha peninsula extending into the Atlantic Ocean from the southeast corner of Aquidneck Island, Rhode Island. The vegetated interior of the point is bordred by a 5 km perimeter of rocky shoreline and cobble beaches. Shrub and herbaceous communities, which dominate the peninsula, are interrupted by a network of roads and scattered buildings abandoned by the U.S. Navy. Bayberry (*Myrica pensylvanica*) is the dominant shrub species. It reaches 3 m in height in the northern section of the point where it occurs in clumps (ca 100-300 m^2) which are interspersed with shorter, mixed stands of goldenrod (*Solidago tenuifolia*) and blackberry (*Rubus* sp.). In the southern part of the peninsula, bayberry from 0.5 to 1.5 m tall forms dense, isolated stands 0.5 to 3.0 ha in area which are surrounded by an herbaceous community. Grasses, especially Autumn Bent (*Agrostis perennans*) and Red Fescue (*Festuca rubra*), are common and occur either alone or beneath a forb layer dominated by goldenrod (*Solidago* spp.) and Black Knapweed (*Centauria nigra*). Shrubs provide the cover throughout 52% of the vegetated region of the study area and herbs cover the remaining area. Elevated perches were absent or scarce within all habitats on the refuge prior to the initiation of this study.

Five dead trees (∓ height = 4.8 m, range = 3.7-8.5 m) with numerous horizontal branches were erected on the refuge in the summer of 1977, and 9 more (∓ height = 4.8 m, range = 3.6-6.1 m) in the summer of 1979. Two trees were erected within the tall shrub community and 5 within the shorter, bayberry stands. The remaining 7 were erected within herbaceous habitats. In the summer of 1978, 9 man-made perches were erected. Each man-made perch consisted of a 6-m board, 5 cm x 10 cm size, fitted with two 2.5 cm dia. dowels. The dowels were cut into 65 cm lengths and centered through holes in the boards so that 30 cm of perch space was available on either side. The dowels were placed on each structure at heights of 2.25 m and 4.5 m above ground. Length of board in excess of 4.5 m was buried. Two perches were placed within tall shrubs, 3 within short shrubs, and 4 within herbaceous communities.

Raptors were observed for 1 h periods on 88 d between 1 September 1978 and 12 March 1979, and on 32 d between 12 November 1979 and 29 January 1980, from the roof of a 6 m high abandoned building near the center of the refuge. Thirty-five visits were made at various times in the morning; 85 were made from 1500 to 1700 h. For each observation of a perched raptor a record was made of species, perched height, individual perch number, and purpose for which the perch was used whenever this was apparent.

Results

Five species of raptors were seen during the 2 years (Table 1). During both periods, the Northern Harrier (*Circus cyaneus*), American Kestrel, and Short-eared Owl (*Asio flammeus*) were dominant. Harriers and kestrels were present in varying numbers throughout both study periods. Four Short-eared Owls arrived in November of 1978 and 1 in December of 1979; each remained until the end of the study period each year. The Sharp-shinned Hawk (*Accipiter striatus*) and Merlin (*Falco columbarius*) occured only as migrants; they were seen on perches in September and October 1978. Raptors were more abundant during the 1978-79 period, averaging 3.7 individuals/hr observation (range = 0-31). An average of 2.6 individuals/hr (range = 0-6 were seen during the shorter, 1979-80 period.

During the 120 h of observation, I made 525 sightings (4.4 sightings/hr) of raptors using the introduced perches (Table 1). All species except Sharp-shinned Hawks used both perch types at least once; sharp-shins used only dead trees. In addition, the Cooper's Hawk (*Accipiter cooperii*), Red-tailed Hawk, Rough-legged Hawk, Peregrine Falcon (*Falco peregrinus*), and Snowy Owl (*Nyctea scandiaca*) were also sighted on the dead trees.

Chi-square (X^2) tests were conducted using each of the 3 dominant raptor species to determine whether the more natural, dead-tree perches were used more than might have been expected by chance. During 1978-79, there were no significant differences ($P = 0.05$) in the use of natural vs. constructed perches for any of the 3 species. In 1979-80, kestrels used dead trees significantly more than expected ($P < 0.001$) ($X^2 = 15.3$, df = 1).

Raptors nearly always perched as high as possible on a perch. On man-made perches, the higher of 2

Table 1. Raptor Perch-Use Statistics.

	Individuals/Day			# Perches Used # Perch Observations*	
Species	∓	range	Percent of Days Present	Dead Trees	Constructed
Sharp-shinned Hawk	0.2	0-10	7	1- 3	-
Northern Harrier	1.4	0- 5	68	6- 35	6- 32
American Kestrel	1.2	0-21	67	14-190	8-149
Merlin	-	0- 1	2	3- 7	1- 1
Short-eared Owl	1.5	0- 4	43	11- 47	8- 61
Total				282	243

*Based on 88 h of observation of 5 dead trees and 9 man-made perches in 1978-79 and 32 h of observation of 14 dead trees and 9 man-made perches in 1979-80.

Table 2. Reported Perch Introduction Experiments.

Source and State	# Perches	Target Species	Raptors Using Perches
Christenson 1972 Utah	3	All Raptors	Swainson's Hawk (*Buteo swainsoni*) Red-tailed Hawk American Kestrel Great Horned Owl (*Bubo virginianus*) Long-eared Owl (*Asio otus*)
White 1974 Utah	8	Golden Eagle	Golden Eagle
Snow 1974 Colorado	2	All Raptors	Red-tailed Hawk Ferruginous Hawk (*Buteo regalis*) Golden Eagle Northern Harrier
Harrison 1977 Michigan	50	Grassland Birds	American Kestrel Short-eared Owl
Steenhof 1977 South Dakota	4	Bald Eagle	Bald Eagle
Steenhof 1977 Oregon	1	Bald Eagle	Bald Eagle
Stumpf 1977 Arizona	12	Bald Eagle	Red-tailed Hawk Harris' Hawk (*Parabuteo inicinctus*)
Hall et al. 1981 California	36	All Raptors	White-tailed Kite (*Elanus leucurus*) Red-tailed Hawk Northern Harrier American Kestrel Common Barn-Owl (*Tyto alba*) Short-eared Owl Great Horned Owl Burrowing Owl (*Athene cunicularia*)
This study Rhode Island	23	All Raptors	Northern Harrier Sharp-shinned Hawk* Cooper's Hawk* Red-tailed Hawk* Rough-legged Hawk* American Kestrel Merlin Peregrine Falcon* Snowy Owl* Short-eared Owl

*Used dead trees only.

available perches was selected in 97% of 32 harrier observations, 99% of 149 kestrel observations, and 85% of 61 Short-eared Owl observations. Except when eating prey, raptors perched within the uppermost branches.

I did not see harriers or owls attack prey from, or consume prey on, an introduced perch. These 2 species apparently used the introduced perches as resting sites between hunting forays. I witnessed 16 prey attacks by kestrels, 14 from man-made perches and 2 from dead trees. Six of the attacks from man-made perches and both from trees were successful. Kestrels were observed eating prey on trees and on man-made perches 10 times each. Kestrels perched more frequently per individual/hr than Short-eared Owls, and owls perched more frequently than harriers.

DISCUSSION

A total of 20 raptor species, representing 2 orders and 4 families, have used perches introduced specifically for their use (Table 2). Although these numbers are impressive, not all attempts at raptor management by perch introduction have been successful. Perches introduced as part of Bald Eagle (*Haliaeetus leucocephalus*) management programs by the U.S. Bureau of Land Management (BLM) (Steenhof 1977) and the U.S. Bureau of Reclamation (Stumpf 1977) were little used by the target species. The BLM had better success with perches introduced for Golden Eagle management; numerous eagles were seen on the perches during the first year after their placement (White 1974). Snow (1974) reports that 4 raptor species used perches placed in a Colorado grassland community, and perches erected in agricultural fields by Hall et al. (1981) received extensive use by 8 species (Table 2).

To determine if introduced perches would serve as a means for enhancing biological control of undesirable rodents, Christensen (1972) placed 3 perches in areas of high pocket gopher (*Thomomys talpoides*) density. Five species of raptors used them (Table 2), and results strongly suggest that gopher numbers were reduced in the area immediately surrounding the perches. Over a broad area, however, the results were inconclusive.

At Sachuest Point I made an average of 1 sighting of a raptor on an introduced perch during each 14 min of observation. The use of the perches by hunting kestrels demonstrates a shift in their hunting strategy as a result of perch introduction, since prior to perch placement aerial hunting was the only method available. Furthermore, the hunting efficiency of kestrels may have improved following perch introduction since several authors have shown that kestrels prefer hunting from a perch rather than hover hunting, and were more successful when hunting from a perch than when hunting aerially in general (Sparrowe 1972, Collopy 1973, Cruz 1976, Bildstein 1978). The perches were also used extensively by kestrels for eating prey.

Despite the substantial documentation of introduced perch, no study has demonstrated an increase in raptor density within managed areas. Stahlecker (1978), however, censused wintering raptors before and after construction of a transmission line. His results demonstrate that raptor density in the area within 0.4 km of the transmission line (57 km^2) became greater than the density in the area beyond 0.4 km (98 km^2) as a result of the extensive use of transmission line towers as perches. The increased density within his study area following transmission line construction suggests a lack of perches was limiting raptor use of his study area.

In areas where the scarcity or absence of perches limits raptor numbers, perch introduction could play an important role in raptor management, at least where an increase in density is the goal. Unfortunately, perch requirements of raptors are not well understood, and it is not always evident if a particular raptor population or community would benefit from increased available perches. In areas where habitat destruction threatens raptor populations, it becomes increasingly important to create potential for increased densities in unaffected range. Managers of protected areas (national parks, public and private wildlife preserves, etc.) should assess perch availability and consider supplementation where a scarcity of perches may limit raptor numbers. Such efforts could help maintain stable raptor populations, especially wintering populations, in threatened areas.

Dead trees erected at Sachuest Point were readily accepted by all raptor species and were preferred by some over man-made perches. Dead trees are preferred perches of Bald Eagles (Steenhof 1977, Stumpf 1977) and were listed as one of the preferred perch types of buteos by Errington and Breckenridge (1938). Thus, trees should be considered for use in perch introduction projects where a source is available.

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Raptor Collisions with Utility Lines — A Call for Information — The U.S. Bureau of Land Management, Sacramento, in cooperation with the Pacific Gas and Electric Company, is assembling all available published and unpublished information concerning collisions of raptors with power lines and other utility lines. Actual case histories — no matter how circumstantial or fragmentary — are needed. Please acknowledge that you have such information by writing to Dr. Richard R. (Butch) Olendorff, U.S. Bureau of Land Management, 2800 Cottage Way, Sacramento, California 95825 U.S.A. (Phone (916) 484-4541). A form on which to record your information will then be sent by return mail.

Kleptoparasitism by White-Tailed Hawk (*Buteo albicaudatus*) on Black-Shouldered Kite (*Elanus caeruleus leucurus*) In Southern Texas

BORJA HEREDIA AND WILLIAM S. CLARK

The White-tailed Hawk (*Buteo albicaudatus*) is a typical open and semi-open country raptor, inhabiting prairies and sparsely forested habitats from southern Texas to central Argentina. It feeds mainly on mammals [e.g. cottontail rabbits (*Sylvilagus floridanus*) and rodents], birds [largely Bobwhite Quail (*Colinus virginianus*) and meadowlarks (*Sturnella* sp.)], reptiles (mostly snakes but some lizards) and insects (e.g. grasshoppers and crickets) (Bent 1937, Cottam & Knappen 1939, Stevenson & Meitzen 1946). Its main hunting technique is to search the ground from a height of 15-50 m (Oberholser 1974) alternating between straight flapping flight, low angle glides and hovering. It's habit of congregating at prairie fires has been recorded on the Texas coast (Stevenson & Meitzen 1946). However, as far as we know, kleptoparasitism has not been recorded for this species.

We observed kleptoparasitism on 30 December 1982 on the King Ranch between Kingsville and Falfurias, Texas. At about 1100 h we spotted a Black-shouldered Kite (*Elanus caeruleus*) flying level at a height of 20 m carrying prey, probably a small mammal. It was pursued by an immature White-tailed Hawk which was gaining on it. As the hawk neared the kite, the kite dropped it's prey and began to harass the hawk. The kite stooped numerous times at the hawk, which turned over and presented it's talons. Two additional immature White-tailed Hawks appeared and were also harassed by the kite. The kite finally left and the 3 hawks searched unsuccessfully for the dropped prey. After they left, we were also unable to find it.

White-tailed Hawks and Black-shouldered Kites are sympatric over much of their range in North America. Recent studies on a Mexican raptor community (Thiollay 1980) showed that there is an 85% overlap in their hunting habitats. Both select areas of tree cover ranging from < 10 to 40% and grass length between < 20 cm to 80 cm. Their hunting techniques also overlap by 90%, both species being typical searchers and aerial hunters. Both also hunt from perches (Warner & Rudd 1975). Although most of their hunting activity occurs late in the day, both may hunt at any time of day (Thiollay 1980).

Except for the habitual kleptoparasites such as the Crested Caracara (*Polyborus plancus*), typical kites (*Milvus sp.*), sea and fish eagles (*Haliaetus* sp.), and the Bateleur Eagle (*Terathopius ecaudatus*), Brown & Amadon (1968, p.73) state that piracy is rare among birds of prey. But piracy has been recorded for 23 other raptor species (Parmenter 1941, Jeserich 1957, Berger 1958, Meinertzhagen 1959, Temple 1969, Reese 1973, Bildstein and Ashby 1975, Hogg 1977, Brockmann & Barnard 1979, Dunne 1981), and especially for other species in the genus *Buteo*: Red-tailed Hawk (*Buteo jamaicensis*) on Peregrine Falcon (*Falco peregrinus*) (Beebe 1960); Rough-legged Hawk (*B. lagopus*) on Northern Harrier (*Circus cyaneus*) (Kirby 1958); Red-shouldered Hawk (*B. lineatus*) on Common Crows (*Corvus brachyrhynchos*) (Kilham 1982); and Common Buzzard (*Buteo buteo*) on Merlin (*Falco columbarius*) and Sparrowhawk (*Accipiter nisus*) (Cramp & Simmons 1979, p. 182). In addition, Clark has observed piracy of a Red-tailed Hawk on Prairie Falcon (*Falco mexicanus*). The Black-shouldered Kite has previously been recorded as the victim of piracy, being robbed by the Lanner Falcon (*Falco biarmicus*) (Reynolds 1974) and by the Peregrine Falcon (*Falco peregrinus*) (Longrigg 1981).

Brockmann & Barnard (1979) pointed out that regular association with other raptor species on or near feeding areas is an ecological factor that appears to promote piracy. Thus the overlap of hunting habitat between the White-tailed Hawk and the Black-shouldered Kite makes this interspecific interaction likely. It would be interesting to know not only how often these encounters occur, but if they are the regular situation.

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OBSERVATIONS OF NESTING PRAIRIE FALCONS IN THE LOS PADRES NATIONAL FOREST

WADE L. EAKLE

PRAIRIE FALCON (*Falco mexicanus*) nesting surveys were conducted by the U.S. Forest Service and California Department of Fish and Game on the Mt. Pinos (MPRD) and Santa Lucia (SLRD) Ranger Districts, Los Padres National Forest during April, May and June, 1981. Nine historical nesting territories were surveyed on the MPRD, of which 4 were active, and 14 historical territories were surveyed on the SLRD, of which 9 were active. An average of 3.3 young hatched per eyrie (N=3). Nine nestlings successfully fledged from these eyries (X=3.0 young per eyrie).

The goal of this study was to survey 2 Ranger Districts on the Los Padres National Forest in southwestern California and determine activity at each eyrie nd productivity at 3 eyries. Productivity parameters provide a measure of reproductive success and allow comparisons with earlier determinations for the same populations (Johnson, 1978).

The survey area encompasses prairie falcon nesting territories in Santa Barbara, Ventura, San Luis Obispo and Kern counties, California.

Prairie falcon eyries were located and plotted on topographical maps during 1979 (Alten and Keasler, 1979). Observation points for viewing the eyries were chosen that provided viewing directly into nest cavities at distances ranging from 30 m up to 1 km. Disturbances were minimized by not climbing to eyries. Observation periods were restricted to 2 h in length. Observations were made with Bushnell 10x50 Explorer binoculars and a Bushnell 20-45x Zoom Spacemaster spotting scope.

Prey remains and reguriated pellets were collected from 2 eyries. Adult Prairie Falcons at BC-1 were observed bringing 1 horned lizard (*Phrynosoma* sp.), 4 ground squirrels (*Spermophilus* sp.) and 1 unknown prey item to the eyrie. At VV-8, adult falcons delivered 3 ground squirrels and 1 western meadowlark (*Sturnella neglecta*) to the eyrie.

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Reuse of Nesting Territories and Eyries. — Three of the 22 known nesting territories have remained active since 1977. Two have remained occupied for 4 of the 5 years that surveys have been completed. The remaining

Table 1: Summary of Prairie Falcon Nesting Activity. Mt. Pinos and Santa Lucia Ranger Districts, Los Padres National Forest. 1977-81.

Eyrie	1977	1978	1979	1980	1981
BC-1	NC	NC	A	A	A
HV-2	NC	NC	A	NC	NA
JW-3	NC	NC	A	NC	A
CR-4	NC	NC	A	NA	NA
SB-5	NC	NC	A	NA	NA
DC-6	NC	NC	A	NA	NA
CC-7	NC	NC	NC	NC	NC
VV-8	NC	NC	A	A	A
LC-9	NC	NC	NC	NC	A
BR-2	A	A	A	A	A
HM-11	A	NA	NA	NA	A
BC-38	A	NC	A	A	A
GM-39	A	A	A	A	A
BT-40	NC	NC	A	A	NC
MM-41	NC	NC	A	A	NC
BR-43	A	NC	NC	NC	NC
BS-45	A	NC	NC	NC	NC
HM-46	A	A	NA	A	A
TC-55	A	A	A	A	A
CC-56	NC	NC	NA	A	A
AC-57	NC	NC	A	A	A
TR-58	NC	NC	NC	NC	A

A - Active; NA - Not Active; NC - Not Counted.

17 were active for 3 years or less (Table 1).

1981 Breeding Season, MPRD. — When surveyed between March 11-18, 5 eyries were active with adult Prairie Falcons in the nest territory. Eight historical eyries were resurveyed in late April and early May. Only 3 eyries, however, remained active. Young hatched at these 3 eyries during the week of May 3-9. Nestlings fledged between June 8 and 19.

Productivity. — Clutch size was not determined. Assuming a minimum clutch size, however, from the brood size of active eyries (N=3), a minimum mean clutch size of 3.7 eggs/nest can be inferred. Brood sizes and fledging success in 1979 and 1981 are summerized in Table 2. For both years the average fledging success is above the 2.56 needed to maintain a stationary population (Garrett and Mitchell, 1973).

Mortality. — Two cases of egg loss or prefledging mortality were observed. When VV-8 was observed on May 17, 1 unhatched egg was present in the nest with 3 nestlings. When observed again on May 31, the egg was no longer present. A 1-2 day old nestling was found directly below the JW-3 eyrie in an emaciated condition.

Nesting Activity. — During 1977, both activity and productivity at prairie falcon eyries on the SLRD was high. Activity and productivity dropped in 1978 for some reason. In 1979 the level of activity at the eyries was lower, but the productivity was higher than the previous year. Activity during 1980 and 1981 appeared to be fairly high and when young were seen at the eyries, they were seen in numbers above the 2.56 fledglings per nest needed to maintain a stable population (Schlorff, 1979).

Productivity and activity at the prairie falcon eyries on the MPRD during 1979 was high. A complete survey was not conducted in 1980, so many eyries that may have been active were determined to be inactive or not counted. Activity at the eyries located in 1979 was down in 1981. Productivity at these active eyries was also lower than the 1979 level.

It is difficult to say why the number of active eyries observed in 1979 was not seen in 1981 on the MPRD. Perhaps the falcons are nesting in alernate areas unknown to the surveyers. Prey did not appear to be limiting. Garrett and Mitchell (1973) stated that the observed rates of prairie falcon production in California during 1971 and

Table 2: Summary of Prairie Falcon Nestling Production. Mt. Pinos Ranger District, Los Padres National Forest. 1979 and 1981.

Eyrie	1979 Brood Size	1979 Fledging Success	1981 Brood Size	1981 Fledging Success
BC-1	4	4	4	4
HV-2	4	4		
JW-3	2*	2*	3	2
CR-4	5	0		
SB-5	5	5		
DC-6	3*	U		
CC-7	U	U		
VV-8	5	5	3	3
TOTAL	28	20	10	9
Mean	4**	3.3***	3.3	3

* - Number may have been greater, but a complete count was not possible.
** - Mean excluding CC-7.
*** - Mean excluding DC-6 and CC-7.
U - Undetermined.

1972 was below expectation and indicated a declining population. However, in the Central region of their study, which includes the area of this study, a production rate in excess of 2.56 fledglings/total pairs was observed. Statewide, they determined an average production rate of 1.59 fledglings/pairs studied. They also observed an extensive shifting of production between eyrie locations in 1970 and 1971, with few of the nesting territories supporting productive pairs in both years. This may be the case on the MPRD.

Sincere appreciation is extended to Cliff Fox and Gary Smith, U.S. Forest Service, and Jim Davis, California Department of Fish and Game, for advice and assistance and to Dr. Stanley W. Harris, Humboldt State University, for directing the field problem.

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Barred Owls and Nest Boxes

DAVID H. JOHNSON AND DON G. FOLLEN, SR.

The use of artificial nesting structures by the Barred Owl (*Strix varia*) has long been assumed. This is due in part to the use of man-made structures by a closely related species, the Tawny Owl (*Strix aluco*) in Europe (Davey 1969). Hamerstrom (1972) gave recommended but untested Barred Owl box dimensions. A literature search reveals 3 published accounts (Johnson 1980, Follen 1982, Synder and Drazkowski 1981) of Barred Owls using artificial structures for nesting. We briefly discuss Barred Owl use of various types of semi-natural and artificial nesting structures in Minnesota, Wisconsin, and Michigan.

Minnesota: Table 1 shows use of artificial and natural cavity nest sites by Barred Owls in north-central Minnesota (Hubbard, Wadena, and Crow Wing counties) during the breeding seasons of 1980, 1981, and 1982. All nesting attempts were successful in fledging from 1 to 4 young. A "# nesting attempts" column is shown as some nests were used in 2 and 3 consecutive years. Average production from 12 nesting attempts in artificial structures was 2.75 young fledged/nesting attempt. Average production in 4 natural cavity nests was 2.00 young fledged/nesting attempt. This difference in production is likely related to the prey abundance/availability within the owls' territory than to a function of nest site quality. However, larger sample sizes are needed to better assess this evaluation. Figure 1 shows the design of the Barred Owl nest box currently being used by the first author. This box is a slightly enlarged Wood Duck (*Aix sponsa*) box with a 17.8 cm diameter entrance hole. Thirty-five of these are currently being field tested in various forest habitats in north-central Minnesota. Heights of nest boxes and topless Wood Duck boxes used by owls have ranged from 3.73-6.70 m (measured from bottom of entrance hole to ground level). Both back-mounted and side-mounted nest boxes (see Fig. 1) have been used by owls (N=2 and N =5 respectively, based on number of nesting attempts).

Table 1. Minnesota Records.

Type of nest	# nests used	# nesting attempts	young fledged
Barred Owl nest box	5	7	18
Topless Wood Duck box	2	4	12
Wood Duck box (with top)	1	1	3
Natural cavity	4	6	12

Wisconsin: In 1966, 3 young Barred Owls were fledged from a topless Wood Duck box, located on Goose Island, La Crosse County. In 1967, this same box contained 2 young. Additional boxes of this type were successful in subsequent years, but unfortunately the particular nesting data were not recorded (J. Rosso pers. comm., F. Lesher pers. Comm.).

A large Barred Owl nest box was established in 1979 by Bill Drazkowski along the Mississippi River backwaters in

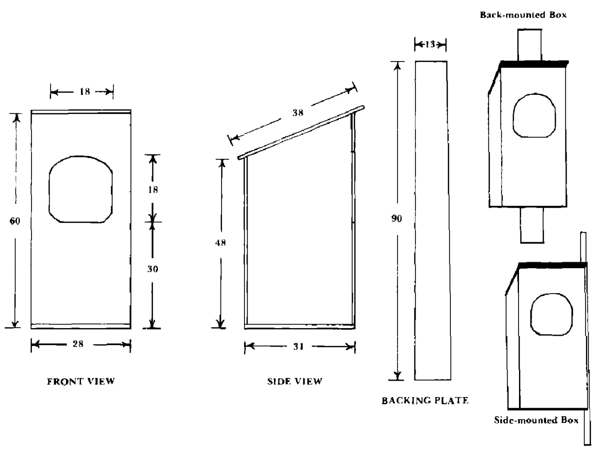

Figure 1. Barred Owl nest box made of wood (1.3 cm thick). All dimensions are in cm.

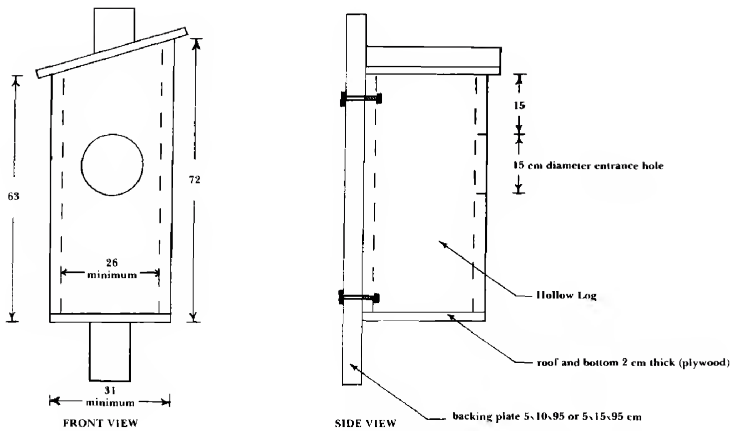

Figure 2. Semi-natural (hollow log) Barred Owl nest cavity. All dimensions are in cm.

Trempealeau County. In 1980 this box contained 2 young, and 3 in 1981. The dimensions of this box were: entrance hole 22.2 x 21.0 cm, bottom of entrance hole to floor of box 33.0 cm, inside floor 33.6 x 36.2 cm. Mr. Drazkowski found the birds to be nesting in the corner of the box, indicating that perhaps such a large box was not required.

In 1981, owls fledged 3 young from a semi-natural nest structure established by Follen in Wood County (Follen 1982). This structure (Fig. 2) consists of a section of a hollow log, with top, bottom and backing plate added. In this structure a 15.2 cm diameter entrance hole was used.

Michigan: In 1977 and 1978 Barred Owls nested in a Red-shouldered Hawk (*Buteo lineatus*) nest in Alpena County. It was unsuccessful, as eggshells and dead young were found beneath the nest. Lewis Scheller (pers. comm.) then established a reconditioned topless Wood Duck box in the area on 2 March 1979. It was used in 1979 and young owls successfully fledged. In 1980 owls again used it, as evidenced by a single infertile egg. In 1981 owls fledged 2 young from 2 eggs, and 3 young from 3 eggs in 1982. This box is approximately 57 cm deep with a bottom of about 31 x 31 cm. Scheller has also established 5 other slightly larger nest boxes, all with open tops. At the time of this writing, none of these have been used by owls.

The availability of suitable nest sites is reported to be a limiting factor for cavity nesting species (Thomas et al. 1979). With current forest management directives of short rotations, intensive culture, etc., this situation is becoming more severe. Although Barred Owls have nested in old hawk or squirrel nests in northeastern US (Bent 1938:183) and in Michigan (L. Scheller per. comm.), in Minnesota they have been recorded only as a cavity nester (Johnson 1982). Beginning in 1980, a five year project was initiated in north-central Minnesota to address the question of artificial nest structures (design, placement, and suitability) for Barred Owls. A project of a similar nature has also been started in Wisconsin. Our findings thus far indicate that Barred Owls do succes fully nest in various types of man-made and semi-natural nest cavities in Minnesota, Wisconsin, and Michigan. A nest box project has also been started in New Jersey by Leonard J. Soucy, Jr.

We thank Catherine M. Fouchi, Douglas Keran, Conrad Schmidt, Jon Carter, Fred Lesher, Dennis Seevers, Bill Drazkowski, Lewis Scheller, Jerry R. Rosso, and Leonard J. Soucy Jr. for their field assistance or other input into this project.

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Ground-Nesting by Barn Owls

MICHAEL E. TEWES

While trapping small mammals on the Aransas National Wildlife Refuge in south Texas, I flushed some Common Barn-Owls (*Tyto alba*) from the ground in a dense stand of gulf cordgrass (*Spartina spartinae*). There were 3 separate tunnel-like pathways through the cordgrass which were apparently being used for roosting. Each cordgrass tunnel was about 1 m long, terminating in a small chamber beneath the grass. The floor of each chamber was littered with owl pellets and skulls of rodents and shrews.

Between November 1980 and January 1981, owls were regularly observed using these cordgrass tunnels for roosting, and in January an abandoned clutch of 4 eggs was found in 1 concealed compartment. I suspected the nest was abandoned after having been flooded during a rainstorm (gulf cordgrass communities normally occur on areas that are periodically flooded). I could not find additional nests or roosts. The grass community had a dominant *Baccharis* shruf influence except for a small 3 ha shrub-free area in which the owl tunnels were located.

These observations are of interest because they provide additional evidence that Common Barn-Owls will nest and roost on the ground. Quigley (Condor 56:315, 1954) found young barn owls in a box with an open top, sunk flush with the surface of the ground in a marsh. It is possible, however, that owls resort to such areas for nesting and roosting only if there is no alternative. The nearest tree or man-made construction that could serve as a nest or roost site was located ovr 4 km away.

Raptor management has received increased attention in recent years. If particular management objectives for an area include enhancing the raptor populations, then attempts should be made to preserve roost and nest sites by not altering selected mature cordgrass stands. Erection of nest boxes (Marti et al., Wildl. Soc. Bull. 7:145-148, 1979) over cordgrass meadows may attract barn owls and support more successful nesting attempts than ground nests. Otteni et al. (Wilson Bull. 84:434-448, 1972) and Delnicki and Bolen (Southwest. Natural. 22:275-277, 1977) provide additional instances of Common Barn-Owl use of nest boxes in marsh areas.

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Welder Wildlife Foundation Contribution No. 155. Rob and Bessie Welder Wildlife Foundation, P.O. Drawer 1400, Sinton, TX 78387. Present address: Caesar Kleberg Wildlife Research Institute, Box 218, Texas A&I University, Kingsville, TX 78363.

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Unusually Low Nesting Site For American Kestrels (*Falco sparverius*)

Clark S. Monson

Two American Kestrel (*Falco sparverius*) nests found in extreme northern Utah were located in small pine stumps on a steep canyon hillside. The nests were less than 45 m apart and both nest holes were only 64 cm above the ground. Higher and seemingly more suitable holes were common in nearby trees but were not occupied by nesting kestrels.

The low nest holes that were occupied did not appear to make the birds more sensitive to human disturbance. On one occasion, I was able to walk directly up to one of the nests and temporarily remove the incubating female before she made an attempt to fly.

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Monitoring Bald Eagle Nesting in Baja California, Mexico

BRUCE CONANT, ALBERT N. NOVARA AND CHARLES J. HENNY

Henney et al. (Auk 95:424, 1978) discussed Bald Eagle (*Haliaetus leucocephalus*) sightings and nesting activity in the vicinity of Bahia Magdalena in Baja California. They confirmed 2 nesting pairs in 1977, apparently the first published record of Bald Eagle nesting in Baja California during the last 50 years.

During an aerial survey of wintering waterfowl on 18 January 1983, the first and second authors found 3 nests (2 occupied) on Isla Creciente. Two were close together (one occupied) at the location (24°22′N, 111°39′W; hereafter abbreviated as 2422-11139) reported by Henny et al. (op.cit.) and an additional one occupied at 2422-11133 also on Isla Creciente. At the latter nest there was an adult eagle incubating 2 eggs with another adult perched nearby. One of the other 2 nests had an incubating adult, but we were unable to flush it off the nest. Assuming an incubation period of 35 days, the eggs seen would not have been laid before mid-December. All nests were made of sticks and located in the crowns of mangrove, but were readily visible from the air. The location of the other nesting pair found by Henney et al. (op.cit.) in 1977 (near San Jorge 2534-11206) was not checked in detail in 1983.

The west coast winter waterfowl survey was conducted by the U.S. Fish and Wildlife Service in cooperation with the Direccion General de la Fauna Silvestre of Mexico as part of the U.S.-Mexico Joint Agreement. Bald Eagle observations were made incidental to the waterfowl survey. We expect to fly annual winter surveys in this area in the future and plan to monitor the status of Bald Eagle nests at both general locations.

Addendum

The nests on Isla Creciente were checked again the following year on 16 January, 1984 during the 1984 Mexico winter waterfowl survey. An incubating adult was found in each of 2 nests (2422-11139 and 2422-11133) but we were unable to obtain an egg count. One flying adult was sighted near San Jorge (2534-11206) but the nest was not located.

U.S. Fish and Wildlife Service, P.O. Box 1287, Juneau, AK 99802. Address of second author: U.S. Fish and Wildlife Service, P.O. Box 1747, Jamestown, ND 58401. Address of third author: U.S. Fish and Wildlife Service, 480 West Airport Road, Corvalis, OR 97333.

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The Seasonal Abundance, Habitat Use and Foraging BehaviorOf Wintering Bald Eagles *Haliaeetus leucocephalus*, in West-Central Illinois

The season abundance, habitat use and foraging behavior of bald eagles wintering near Lock and Dam 19, Mississippi River, were investigated by regular census taking and intensive behavioral sampling during the winters 1978-79 and 1979-1980. The ultimate objectives of the study were to provide information necessary for an Environmental Impact Analysis of a proposed Mississippi River bridge and highway corridor on wintering bald eagles and to obtain information useful to management of winter bald eagle habitat.

The two study seasons contrasted greatly in weather severity. During the severe winter of 1978-79, 8263 eagles were recorded on 59 censuses. The peak count for this season was 454 eagles on January 18. During the mild winter of 1979-80, 4230 eagles were recorded on 97 censuses. The peak count this season was 127 eagles on February 18. Eagle abundance varied considerably each season; the greatest numbers were recorded during the coldest periods of each winter. The effects of weather severity on the eagle population of the study area are discussed. Overall, adult eagle outnumbered immatures by 2.28 to 1; however, age class composition varied over the course of each season. Immatures comprised a greater proportion of the eagle population during the early and late parts of the season.

The daily activities of eagles included foraging and eating, flying, loafing and night-roosting. Eagles typically used different portions of the study area for each of these activities, especially when the eagle population was large. Habitat use data were obtained from 10,710 locations of perched eagles plotted on census forms. Ice cover, wind exposure, human activity and local food concentrations were the most important factors determining the daily use of suitable perching habitat. Eagle dispersion was most clumped when ice cover on the river was at a maximum, and most uniform when the river was ice-free.

Eagles use of foraging areas was greatest in the morning and diminished as the day progressed; however, when large numbers of eagles were present, eagles were observed foraging during all daylight hours. Use of loafing areas peaked in the middle of the day.

The prey base of eagles in the study area was dead or injured fish, primarily gizzard shad (*Dorosoma cepedianum*). Six behaviorally distinct foraging strategies were identified and are described. By far the most commonly used, and the most intensively studied of these was Strategy 1, an aerial search, swoop and capture of prey. Eagles fishing via this method were successful approximately 70% of the time and averaged less than 5 minutes of flight time per fish captured. Adults were significantly more successful in capturing fish and averaged shorter flight duration per fish captured than immatures. Approximately 70% of the fish captured were small (15 cm. or less) and the size of fish taken was similar for both age classes. Over 97% of small fish captured by eagles were successfully consumed. Most small fish (71.0%, N= 1181) were consumed in flight. Nearly 37% of large fish (greater than 15 cm) captured by eagles were lost (pirated or accidentally dropped) prior to being consumed. Most large fish (51.5%, N= 504) were eaten at tree perches.

Eagles readily attempted to steal prey from other fish predators, even though food was generally abundant. Eagles attempting interspecific piracy were relatively more successful (55.4%, N= 65) than eagles attempting intraspecific piracy (14.3%, N = 154). Eagles carrying large fish were more vulnerable to piracy, and were more likely to be attacked than were eagles carrying small fish. Intraspecific piracy increased in frequency as foraging eagles became more concentrated. Foraging eagles exhibited many behaviors designed to prevent the loss of procured prey to other eagles. These pirate avoidance and pirate defense strategies are discussed. — **Fischer, David Lawrence. 1982. M.S. Thesis. Western Illinois University, Macomb.**

Ecology of Bald Eagles Wintering in Southern Illinois

The population size, food habitats, distribution, and habitat of wintering Bald Eagles (*Haliaeetus leucocephalus*) were investigated in Illinois at Union County and Horseshoe Lake conservation areas during 1979-1981. Crab Orchard National Wildlife Refuge was examined also during 1980-1981.

Eagles arrived in southern Illinois during late October with estimated peak populations of 180-200 occurring, dependent upon weather conditions, in January and February; eagles departed by early March. Immature eagles predominated in wintering populations, but adult and immature subpopulations displayed similar patterns of fluctuations in numbers. Morning and evening roost counts provided an accurate estimate of total population size and automobile transact counts provided data on eagle distribution and habitat utilization patterns.

Diurnal perch sites near shallow water areas were utilized most during early winter. Occurrence of ice cover caused eagles to shift to areas of open water where waterfowl also concentrated. Canada Goose (*Branta canadensis*) carcasses appeared to be the principal food at this time, though unsuccessful eagle attacks were witnessed on injured or dying waterfowl. During late winter, eagles appeared less reliant on refuges for feeding. This may have been associated with spring migration.

Food availability was considered the major influence on the selection of diurnal perch sites. Protection from winds and insulation from human disturbance appeared to be of secondary importance. Communal roosts offered shelter from prevailing winds by surrounding vegetation and were associated with standing water. Most eagles left the roost by sunrise and returned by 20 min after sunset. Times of vocalization and movement were similar to those of entrance and departure. — **Sabine, Neil. 1981. M.S. Thesis, Southern Illinois University, Carbondale.**

"The Peregrine Falcon At Reelfoot Lake"

By Murrell Butler
Limited Edition Print of 2,500

A tree-nesting "Duck Hawk" populated the Mississippi and Ohio River areas in times past. A remnant nesting population was first documented during the 1930's at Tennessee's Reelfoot Lake by the late Albert F. Ganier. During the 1940's a new nest site was discovered on the west side of the lake by Dr. Walter R. Spofford, then Professor of Anatomy at Vanderbilt University. Dr. Spofford and a few carefully selected observers made yearly nesting observations until the early 1950's.

Mr. Thomas S. Butler was privileged to have been among those who spent many days recording the events of each year's breeding season beneath the enormous cypress tree that served as the falcons' nest site. During the late 1970's a happy circumstance led Tom to meet Murrell Butler, a distant cousin from Louisiana. Murrell was an accomplished wildlife artist and became enthralled by the tales of a Peregrine Falcon that once nested in the snag of the mammoth cypress tree. A subsequent trip to the nest site (the cypress still stands!), the relocation of old photographs and consultation with friends and fellow falconers culminated in this magnificent painting by Murrell Butler.

"The Peregrine Falcon at Reelfoot Lake" portrays the last known North American tree nest of the Peregrine. Available in a 16" by 20" limited edition print of 2500, the introductory price is $65.00 for prints #1 - #500. The introductory price includes postage within the fifty states and a $10.00 donation to The Raptor Research Foundation, Inc. The price will advance to $125.00 per print for #2001 - 2500, according to the following schedule: #1 - 500, $65.00; #501 - 1000, $75.00; #1001 - 1500, $85.00; #1501 - 2000, $95.00; #2001 - 2500, $125.00; Arkansas residents will need to add state, city and /or county sales tax). Prints may be ordered directly from Mr. Thomas S. Butler, Butler Galleries, 28 Fairmont Street, Eureka Springs, Arkansas 72632, USA. Payment may be made by check, money order, VISA or MASTERCARD.

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Submit a typewritten original and **two** copies of the text, tables, figure headings, and all other materials for use by the referees. Submit three copies of all illustrations. **All** typewritten material must be **double-spaced** on one side of 8½ x 11-inch (21½ x 28cm), good quality, bond paper, with at least 1 inch (2½ cm) margins. Do not use erasable, mimeo, or light-weight bond paper. Copies may be Xerox or carbon reproductions of good, clear quality. Number pages through the Literature Cited section of the manuscript. Type the author's name in the upper right-hand corner of every page. Submit each table on a separate unnumbered page; combine legends for illustrations on one unnumbered page whenever possible. Material submitted in tables or illustrations should not be repeated in the text of the manuscript. Write mathematical formulas on one line whenever possible. Each manuscript should include a cover page containing a concise, informative, full title, a shortened version of the title (not to exceed 35 characters in length) to be used as a running head, and the name(s) of the author(s) as it should appear in print. Avoid footnotes and hyphenation.

Address for each author at the time the research was conducted should be listed at the end of the manuscript following the Literature Cited section. Present address of author(s), if different, should be listed, as well as name and full address to whom proof is to be sent. If you are no longer associated with the institution where the research was conducted, but you wish to credit that institution, it may be mentioned first.

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Authors should cite the scientific and (if any) common names of all species at first mention in **both** the abstract and the main text of the manuscript. Names for birds should follow those in the A. O. U Check-list of North American Birds (sixth ed., 1983), or an appropriate equivalent. Subspecific identification should only be cited when pertinent to material presented in the manuscript. In all cases where the scientific and common names are cited together, the common name should be placed first.

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Commentary on articles published in *Raptor Research* is invited by the Editor. Comments should be in letter form submitted in duplicate to allow one copy to be forwarded to the author whose work is being addressed. The recipient will be invited to reply. All submissions should be typed, double-spaced, signed, and be as brief as possible. Contributions to the Commentary section will be reviewed by the Editorial Board, which will select contributions for publication that are most pertinent to the interests of our readership.

Announcements of noncommercial raptor news, requests for assistance, etc., are invited by the Editor. Items submitted should be typed **double-spaced** in *Raptor Research* format. Announcements that carry a dead-line should be submitted at least **six months** in advance to allow enough time for publication and response. Advertisement notices will be published free of charge providing 15% of the proceeds requested are donated to The Raptor Research Foundation, Inc. All other advertisements will be charged at a rate consistent with current publication costs in effect at the time the ad request is received. The journal also publishes notices about selected new books, booklets, reports, etc., that are received in the editorial office. Authors and publishers are encouraged to submit a copy of their material for consideration and not just an announcement. Insure that price and source for all such material is given. A review of material when appropriate will be requested by the Editor and published in the journal.

PUBLICATON POLICY

The cost of producing an issue of *Raptor Research* is expensive, and membership dues alone do not meet the publication costs. In order to defray some of the costs of publishing the journal, it is the policy of The Raptor Research Foundation, Inc., to expect authors of manuscripts accepted for publication to contribute to these costs through the use of institutional, grant or contract, or other funds available to them for this purpose. Those authors who are able to completely subsidize publication of their papers will be scheduled for publication in the earliest available issue of *Raptor Research* following approval of galley proofs. Authors who are members of The Raptor Research Foundation, Inc., but do not have access to institutional, grant or contract, or other funds may request a waiver of contributions toward publication costs. Authors of lengthy manuscripts are especially encouraged to help defray the costs of publication. It is unlikely that articles of more than 10 printed pages (i.e., 18 typewritten, double-spaced pages of manuscript including tables and illustrations) can be published without a significant contribution. The ability to contribute toward publication costs does not enter into the editorial decision regarding the acceptability of a manuscript.

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Reprint charges will be forwarded to authors at the same time as the article galley for proofing. The Raptor Research Foundation, Inc., will not waive the cost of reprints of articles requested by authors. Payment in full for requested reprints must be forwarded to the Treasurer before reprints can be mailed. However, authors employed by government agencies, universities, or other firms that will meet their reprint costs, may forward an intent to pay to the Treasurer in the form of an agency voucher/purchase order. Upon receipt of a voucher/purchase order, reprints can be mailed to the author. The Treasurer will then bill the appropriate agency for the reprints with the understanding that payment will be made within 30 days.

All funds should be made payable to The Raptor Research Foundation, Inc., and forwarded directly to the Treasurer: Dr. Gary E. Duke, Department of Veterinary Biology, 295K Animal Science/Veterinary Medicine Building, University of Minnesota, St. Paul, Minnesota 55108, U.S.A. All personal contributions towards publication costs, as well as other personal costs of preparing papers for publication, are tax-deductible.

Copies of these instructions are available upon request from the Editor, to whom correspondence regarding contributions to *Raptor Research* should be forwarded.

RAPTOR RESEARCH
A QUARTERLY PUBLICATION OF THE RAPTOR RESEARCH FOUNDATION, INC.

Raptor Research (ISSN 0099-9059) welcomes original manuscripts dealing with all aspects of general ecology, natural history, management and conservation of diurnal and nocturnal predatory birds. Send all manuscripts for consideration and books for review to the Editor. Contributions are welcomed from throughout the world, but must be written in English.

INSTRUCTIONS FOR CONTRIBUTORS: Submit a typewritten original and two copies of text, tables, figures and other pertinent material to the Editor. Two original copies of photographic illustrations are required. *Raptor Research* is published in a double-column format and authors should design tables and figures accordingly. **All submissions must be typewritten double-spaced** on one side of 8½ x 11-inch (21½ x 28cm) good quality, bond paper. Number pages through the Literature Cited section. The cover page should contain the full title and a shortened version of the title (not to exceed 30 characters in length) to be used as a running head. Author addresses are listed at the end of the Literature Cited section. Authors should indicate if present addresses are different from addresses at the time the research was conducted. When more than one author is listed, please indicate who should be contacted for necessary corrections and proof review. Provide an abstract for each manuscript more than 4 double-spaced typewritten pages in length. Abstracts are submitted as a separate section from the main body of the manuscript and should not exceed 5% of the length of the manuscript. Acknowledgements, when appropriate, should immediately follow the text and precede the Literature Cited. Both scientific and common names of all organisms are always given where first appearing in the text and should conform to the current checklists, or equivalent references, such as the A.O.U. Checklist of North American Birds (6th ed., 1983). Authors should ensure that all text citations are listed and checked for accuracy. If five or fewer citations appear in the text, place the complete citation in the text, following these examples: (Brown and Amadon, Eagles, Hawks and falcons of the World. McGraw-Hill, New York. 1968), or Nelson (*Raptor Res.* 16(4):99, 1982). If more than five citations are referenced, each should include author and year (e.g., Galushin 1981)), or in a citation with three or more authors, the first author and year (e.g., (Bruce et al. 1982). Citations of two or more works on the same topic should appear in the text in chronological order (e.g., (Jones 1977, Johnson 1979 and Wilson 1980). Unpublished material cited in the text as "pers. comm.," etc., should give the full name of the authority, but must not be listed in the Literature Cited section. If in doubt as to the correct form for a particular citation, it should be spelled out for the Editor to abbreviate.

Metric units should be used in all measurements. Abbreviations should conform with the Council of Biology Editors (CBE) Style Manual, 4th ed. Use the 24-hour clock (e.g., 0830 and 2030) and "continental" dating (e.g., 1 January 1984).

Tables should not duplicate material in either the text or illustrations. Tables are typewritten, **double-spaced throughout**, including title and column headings, should be separate from the text and be assigned consecutive Arabic numerals. Each table must contain a short, complete heading. Footnotes to tables should be concise and typed in lower-case letters. Illustrations (including coordinate labels) should be on 8½ x 11-inch (21½ x 28cm) paper and must be submitted flat. Copies accompanying the original should be good quality reproductions. The name of the author(s) and figure number should be penciled on the back of each illustration. All illustrations are numbered consecutively using Arabic numerals. Include **all** illustration legends together, typewritten **double-spaced**, on a single page whenever possible. Line illustrations (i.e., maps, graphs, drawings) should be accomplished using undiluted india ink and designed for reduction by 1/3 to ½. Drawings should be accomplished using heavy weight, smooth finish, drafting paper whenever possible. Use mechanical lettering devices, pressure transfer letters, or calligraphy. Typewritten or computer (dot matrix) lettering is **not** acceptable for illustrations. Use of photographic illustrations is possible but requires that prior arrangements be made with the Editor and the Treasurer.

A more detailed set of instructions for contributors appeared in *Raptor Research*, Vol. 18, No. 1, Spring 1984, and is available from the Editor.