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NESTING ECOLOGY OF FERRUGINOUS HAWK IN NORTHWESTERN NEW MEXICO

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ABSTRACT.—Ferruginous Hawk (*Buteo regalis*) nesting biology and habitats were studied in northwestern New Mexico from 1981–88. A total of 72 nest sites were located. The maximum number of breeding pairs recorded in any 1 year was 26. Clay or rock pinnacles were the most commonly used nest substrate. Nests were most frequently (56.9%) located in steeply eroded "badland" habitat even though this habitat type comprised only 3.9% of the total area studied. Nest building began in early March and fledging peaked during the last week in June. Mean number of young fledged per successful nest was 2.4. Mean number fledged per breeding pair was 1.8. The primary threat to Ferruginous Hawk in the study area was human disturbance caused by increased human settlement and recreational use of the badlands.

Ecología de la nidificación de *Buteo regalis* en el noroeste de Nuevo México

RESUMEN.—Desde 1981–88 se estudió la biología de nidificación y hábitats de *Buteo regalis* en el noroeste de Nuevo México. Se ubicó un total de 72 sitios de nidificación. El mayor número de parejas reproductivas registradas en un año fué de 26. Cimas rocosas o arcillosas fueron las más usadas como sustrato de nidificación. Los nidos estuvieron frecuentemente (56.9%) localizados en pendientes fuertemente erosionadas de barrancos, aún cuando este tipo de hábitat comprendía solamente el 3.9% del área total estudiada. La construcción del nido comenzó a principios de marzo y el número máximo de volantones se obtuvo durante la última semana de junio. El número promedio de jovenes volantones por nido exitoso fue 2.4. El número promedio de volantones por par reproductivo fur 1.8. La amenaza principal para esta especie en el área de estudio fue la perturbación humana. Causada por el aumento de establecimientos humanos y uso recreascional de estos sitios.

[Traducción de Ivan Lazo]

Little is known concerning the biology of the Ferruginous Hawk (*Buteo regalis*) in the southwestern United States (Hall et al. 1988). The species has been reported as a rare to uncommon nesting resident of New Mexico (Ligon 1961, Hubbard 1978). Tolle (1977) located an occupied nest in a coal lease area near Farmington but no large scale surveys for this species have been reported for this area.

The purpose of our study was to determine the number of Ferruginous Hawks nesting in areas of potential mineral and gas development and to identify factors affecting the use of nesting habitats. The original focus, starting in 1981, was on BLM administered lands in potential coal lease areas. As inventory and monitoring continued the study became more intensive. In 1986, the Bureau of Indian Affairs and the Navajo Game and Fish Department joined the study and began examining Ferruginous Hawk habitat on Navajo Indian lands.

STUDY AREA

The study area began as a 1619 km × 16 km belt starting 48 km south of Farmington, New Mexico and extending southeast to Cuba, New Mexico. In 1986, about 400 km^2 of

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Navajo Reservation land was added to the study area and searched for nests during the breeding season. In 1987, the study area was expanded to its final size of 5504 km², including 4289 km² of public land in the BLM Farmington Resource Area and 1215 km² of Indian land in the northeast corner of the reservation. Elevations in the study area ranged from 1524–2134 m. Annual precipitation averaged 25–36 cm.

Vegetation in the study area was characterized by gently rolling sandy grasslands dominated by Indian ricegrass (*Oryzopsis hymenoides*), sandhill muhly (*Muhlenbergia pungens*), and snakeweed (*Xanthocephalum sarothrae*). On mixed shrub/grass uplands the dominant species were fourwing saltbush (*Atriplex canescens*), green rabbitbrush (*Chrysothamnus viscidiflorus*), snakeweed, galleta grass (*Hilaria jamesii*), and blue gramma (*Bouteloua gracilis*). Interspersed between these areas were broad, low flatlands bearing alkali sacaton (*Sporobolus airoides*), and areas of unvegetated exposed clay soil and rock outcrop classified as "badlands" or badland complex (Keetch 1980). Badland areas ranged from a few to many thousand ha in size. In the northern portion of the study area, grasslands and mixed shrub/grass uplands were replaced by big sagebrush (*Artemisia tridentata*)/grass uplands. There were numerous ephemeral drainages bordered by narrow (2–40 m wide) bands of black greasewood (*Sarcobatus vermiculatus*) and rubber rabbitbrush (*Chrysothamnus nauseosus*). Utah juniper (*Juniperus utahensis*) and pinyon (*Pinus edulis*) occurred at higher elevations and, occasionally, in areas of rock outcrops in the grasslands. Fremont cottonwood trees (*Populus fremontii*) occurred infrequently along drainages and edges of stock ponds.

All of the study area was grazed by either cattle, sheep, goats, or horses. Human habitation was sparse and limited to widely scattered houses or small clusters of houses occupied by Navajo ranchers or herders. In the northwest corner of the study area, native grasslands were being converted into cultivated fields as part of the Navajo Indian Irrigation Project. In 1988 approximately 21 400 ha were under cultivation for production of alfalfa (*Medicago sativa*), corn (*Zea mays*), beans (*Phaseolus vulgaris*), potatoes (*Solanum tuberosum*), and onions (*Allium cepa*). Three small (<300 ha) and two large (>1000 ha) coal mines were active in the study area.

METHODS

Nests were located by both ground and aerial searches. Approximately 100 hr of helicopter and 16 hr of fixed-wing flight time were used. Nests were recorded on parallel transects, flying at altitudes of 30–200 m between late March and mid-May in 1981 and 1984–87. Ground searches were conducted on foot and with the use of 4-wheel drive vehicles. They were usually concentrated in areas where adult Ferruginous Hawks were observed but no nest had been previously located.

Stereographic aerial photographs and orthophotographs were used to plot the exact location of each nest on topographic maps (scale 1:24 000). Height of the nest above the surrounding terrain and description of the nest substrate were also recorded. Detailed vegetation measurements were not part of our study. However, some habitat information was gathered for nests located on public land. The vegetation within a radius of 100 m of the nest site was visually classified into one of five general habitat types based on an ocular estimation of the dominant plant community. These habitat types were: grassland, rabbitbrush/greasewood, big sagebrush, pinyon/juniper woodland, and badlands. Grassland was composed of communities in which Indian rice grass, alkali sacaton, blue gramma, or galleta grass dominated. Rabbitbrush/greasewood consisted primarily of shrub communities along drainages and flat areas that were seasonally flooded. Big sagebrush habitat was dominated by sage plants but often had a grass understory. Areas were classified as pinyon/juniper habitat if they contained >4 trees/ha and trees were in a stand >5 ha. Badlands were unvegetated areas of actively eroding clay soil and rock outcrop. The percent of each type present on public land in the study area was obtained by planimetering existing vegetation communities delineated on broad scale (1:126 720) rangeland survey maps prepared for BLM land use plans. Equivalent mapping was not available for the reservation portion of the study area. Surrounding habitat type was not recorded for nests on the reservation.

Nests with evidence of eggs or young were considered active. Productivity data were gathered from all active nests Occupied nests (incubating adult present) were observed from at least 300 m with a 20–60× spotting scope to avoid disturbance. All occupied nests were revisited at least once late in the nesting season to count the number of young. Ages of young were estimated using the pictorial guide developed by Moritsch (1985). Unless field evidence indicated otherwise, nests containing young 30 d or older were considered successful.

RESULTS AND DISCUSSION

Nests. A total of 72 Ferruginous Hawk nests (51 on public land, 21 on reservation land) was located between 1981–88. Based on observations of nest use in successive seasons, we believe this represented a minimum of 35 different territories used over the years. As many as five nests were contained in a single territory. The maximum number of breeding pairs we recorded in a single breeding season was 26.

Nest height and substrate type were recorded for all 72 nests. Height of nests above the surrounding terrain averaged 7.7 m (range 0.0–24.6 m, SD = 6.1 m). Nest size and construction were typical of that described in other areas (Weston 1969, Olendorff 1973, Woffinden and Murphy 1982). On two occasions existing old nests virtually disappeared as new nests were constructed nearby suggesting that sticks from the old nests were used to construct new ones.

Of the 72 total nests, 86% were situated on the tops of clay or rock pinnacles, 6% on cliffs and 4% were on the ground. Only 3% of the nests in our study area were in trees. Trees are a preferred nest substrate in some locations (Howard and Wolfe 1976, Smith and Murphy 1978, Gilmer and Stewart 1983, Perkins and Lindsey 1983, Woffinden and Murphy 1983, Schmutz 1984). Cliffs and trees were preferred nest substrates in Washington (Bechard et al. 1990).

Table 1. Occurrence by habitat type of 51 Ferruginous Hawk nest sites on 4289 km^2 of public land in northwestern New Mexico between 1981–88. Data from the Navajo Indian Reservation are not included. Confidence intervals are calculated according to Neu et al. (1974) and are based on a 90% family confidence coefficient.

HABITAT TYPE	NUMBER OF NESTS OBSERVED	PROPORTION OF AREA IN EACH HABITAT TYPE	PROPORTION OF NESTS OBSERVED IN EACH TYPE (p_i)	CONFIDENCE INTERVAL ON PROPORTION OF OCCURRENCE
Badlands	29	0.039	0.569	$0.388 \leq p_1 \leq 0.746$
Rabbitbrush/greasewood	9	0.069	0.176	$0.039 \leq p_2 \leq 0.313$
Grasslands	12	0.334	0.235	$0.082 \leq p_3 \leq 0.388$
Big sagebrush	1	0.190	0.020	$-0.031 \leq p_4 \leq 0.071$
Pinyon/juniper	0	0.368	0.0	—

Habitat data were gathered from the 51 nests on public land (Table 1). A goodness-of-fit comparison indicated the expected number of nests in each habitat type differed significantly from the occurrence of general habitat types ($\chi^2 = 405.1$, df = 4, $P < 0.001$). Calculation of confidence intervals by habitat type (Neu et al. 1974) revealed that badland sites were used significantly more than expected, while big sagebrush and pinyon/juniper were used significantly less often ($\alpha = 0.10$). The proportion of nests located in grassland and rabbitbrush/greasewood habitat were within the confidence intervals for expected values.

Frequently, small badland areas surrounded by grassland were selected for nest sites. Such sites apparently serve as a special habitat feature by providing abundant erosional remnants and rocky pinnacles which are preferred as nest substrates (Evans 1983). Blair and Schitoskey (1982) also found Ferruginous Hawk nests in South Dakota in ungrazed or lightly grazed prairie or badlands surrounded by prairie.

Nests in rabbitbrush/greasewood habitat were usually placed on eroded pinnacles adjacent to a wash or drainage channel. Nests in grassland were usually located on small buttes or similar erosional remnants, while the one nest in big sagebrush habitat was located on a low cliff face. Further work is needed to define more narrowly the habitat factors which may influence nest site selection in our study area.

Nesting Chronology. Adult Ferruginous Hawks were observed in courtship or nest building activity as early as the first week in March. A similar date was reported for Utah and southern Idaho (Howard 1975, Smith and Murphy 1978). Although downy young were seen in nests as early as the first week in May, most nests contained eggs at that time. Fledging dates were estimated for 67 successful nests. The majority (82.1%) fledged young between 19 June and 6 July with the peak (35.8%) occurring between 25 and 30 June.

Nest Productivity. Nest productivity (Table 2) was similar to that reported for Ferruginous Hawks in South Dakota (Lokemoen and Duebbert 1976), Utah (Howard and Wolfe 1976, Woffinden and Murphy 1977, Smith and Murphy 1978) and Colorado (Olendorff 1973) but less than that recorded in Alberta (Schmutz et al. 1980) and Nevada (Perkins and Lindsey 1983).

Woffinden and Murphy (1989) state a productivity of 1.5 young/pair/yr is needed to maintain a stable

Table 2. Productivity of Ferruginous Hawks monitored in northwestern New Mexico from 1981–88. Successful pairs were defined as those raising young to an age of at least 30 d. Increases in number of breeding pairs during periods 1983–84 and 1985–87 were due to increases in size of study area.

YEAR	BREEDING PAIRS	SUCCESSFUL PAIRS (% OF TOTAL)	MEAN BROOD SIZE	MEAN NO YNG./PAIR
1981	4	3 (75)	2.0	1.5
1982	4	4 (100)	2.5	2.5
1983	3	2 (67)	2.5	1.7
1984	7	6 (86)	2.5	2.1
1985	7	6 (86)	1.7	1.4
1986	12	8 (67)	2.0	1.3
1987	26	19 (73)	2.6	1.9
1988	26	19 (73)	2.7	2.0
All years combined	89	67 (75)	2.4	1.8

population of Ferruginous Hawks, assuming a 65% juvenile mortality and 25% adult mortality. The productivity for the last 2 yr of our study, the period in which study area size was constant, appeared to exceed that needed for stability. Woffinden and Murphy (1989) also found a reduction in productivity in response to decreased prey availability indicating that our short term productivity estimate may not be an accurate assessment of Ferruginous Hawk productivity in this study area. An assessment of prey relationships and continued long-term monitoring of productivity is needed before any conclusions can be made concerning the stability of this population.

Potential Impacts on the Population. The Ferruginous Hawk is prone to nest desertion and reduced productivity if disturbed prior to or during incubation (Fyfe and Olendorff 1976, White and Thurow 1985). Homestead development on Indian lands and recreational use of the badlands were the most common sources of disturbance in this area. New homes were being built by Navajo settlers in previously unoccupied areas and we documented two cases of nest failure due to apparent disturbance caused by nearby residents.

Agricultural development can adversely affect nest density (Schmutz 1984). Since completion of our study, Ferruginous Hawks have constructed nests and successfully raised young in badlands adjacent to the irrigated croplands of the Navajo Irrigation Project (K. McCoy pers. comm.) indicating that cultivation has not yet adversely impacted Ferruginous Hawks in this area. No nests were located in the developed areas prior to cultivation nor do we have data to indicate that these areas provided important foraging sites for Ferruginous Hawks before being developed. Likewise existing coal, oil, and gas development have not adversely impacted this population.

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