NESTING OF FERRUGINOUS HAWKS (*BUTEO REGALIS*) IN WASHINGTON 1974–75

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The first comprehensive study of the Ferruginous Hawk (*Buteo regalis*) in Washington was conducted by Bowles and Decker (1931), who described nests, clutch sizes, food habits, interspecific relations, and habitat utilization. Angell (1969) provided a further report concerning the behavior of one pair of nesting birds.

Since the Bowles and Decker (1931) study, the lands of eastern Washington have undergone a tremendous change, resulting from intensive dryland wheat farming, irrigation, water diversion and impoundment, and urban sprawl. The Washington Department of Game has been concerned about the impact these land changes are having on native wildlife species. In particular, they wanted to know if the Ferruginous Hawk was still present on the remaining undisturbed areas. This study was conducted to ascertain the present status of the species over its historical range in Washington and to establish a baseline from which additional land perturbation impacts can be determined.

The majority of the studies dealing with Ferruginous Hawks have been conducted in the Great Basin region of western North America. Woffinden (1975), Smith and Murphy (1973), and Weston (1969) confined their studies to Utah, while Howard and Wolfe (1976) and Powers et al. (1975) reported on Ferruginous Hawks in both northern Utah and southeastern Idaho. Olendorff (1973) studied the species outside the Great Basin region in north-central Colorado. Studies in other areas of western United States and in the provinces of Canada are necessary in order to fully assess the status of this species on its breeding range in North America.

This study provides data on population levels in southeastern Washington and describes two facets of the hawks' behavior (diet and nest site selection) that influence nesting success.

STUDY AREA AND METHODS

The study area comprised 38,848 km² in southeastern Washington (Fig. 1), extending over 12 counties, excluding the Blue Mountains. The natural vegetation of the study area is classified as steppe (Daubenmire 1970) and lies in the rain-shadow of the Cascade Mountains. Most of the native vegetation of the basin has been either destroyed by cultivation and water impoundment, or greatly modified by fire and livestock grazing. Much of the unmodified area is channeled scabland, formed when glacial floods bared large tracts of basalt, and scoured canyons and deep valleys (U.S. Dept. Interior 1973).

A small portion of the study area, approximately 117 km² in southern Franklin Co., consists of glaciofluvial deposits of sand. The unique feature of this area is the presence of western junipers (*Juniperus occidentalis*) which form savannahs of variable size separated by tracts of moving sand dunes. These trees are apparently at the northernmost limit of their range in North America (Vasek 1966). We found that the channeled scablands and juniper-savannah areas were the principal habitats used for nesting by the Ferruginous Hawk. These habitats were selected for intense investigation.

The climate in the study area is characterized by moderately cold winters and hot summers. The daily mean of the coldest month is between –5.5 and 1.5°C, while the daily mean of the hottest month is between 18.5 and 24.5°C (Daubenmire 1970). Precipitation is mostly confined to the fall and winter months.

We found nest sites from previous years by talking with people in the Washington Department of Game, falconers, and bird watchers, as well as from data on museum specimen labels. Recent sites were located by direct observation and by watching adult hawks soaring or carrying nesting material. The term "nest site" denotes a nesting location; more than one nest may be present, but only one is used for egg laying at any one time. A site was considered active if a pair of hawks was present and if we had some evidence of nest building that year.

In 1974, searches for nests were conducted in April, May, June, and July. The April and early May survey overlapped the birds' incubation period and may have caused a nest desertion. In 1975, we therefore limited our nest searching to late May, June, July, and August. Automobile, aircraft, boat, and foot travel were all used in the survey.

The kinds of nesting materials used and linear dimensions of nests were recorded for five tree nests and eight rock outcrop nests. Food habits were determined in 1975 by tabulating prey items and analyzing pellets gathered from two nests: one a rock outcrop nest in channeled scabland in northern Franklin Co. and the other a juniper tree nest in southern Franklin Co. Techniques described by Errington (1932), Moon (1949), and Mayer (1952) were employed. Relative percent frequency estimates were calculated for each prey taxa on the

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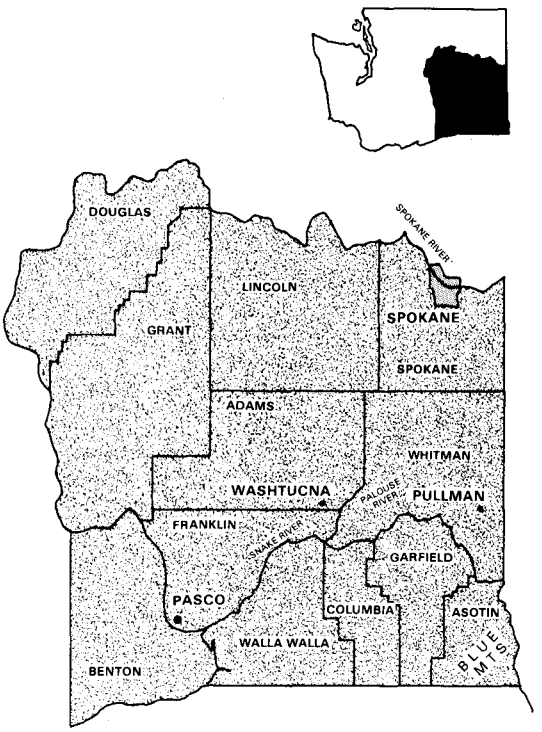

FIGURE 1. Map of Washington, showing location of 38,848 km² study area.

basis of total number identified (Curtis and McIntosh 1950).

RESULTS

DESCRIPTION OF NESTS AND NESTING SITES

Thirty-one nest sites, with 71 nests, were found. Of these sites, 25 contained a total of 65 nests, all situated on rock outcrops in scabland habitat. A single site usually contained more than one nest; one site had eight. Mated pairs may refurbish one or more nests used in prior years, or they may construct a new one. Nests are often placed on a rock shelf or outcrop located on hillsides or in canyons. No nests were found on flat ground.

Six nest sites were in trees. All of the tree nest sites contained only one nest. One tree nest in Benton Co. was situated in a small black locust (*Robinia pseudacacia*). The nest was not used during either the 1974 nor the 1975 survey. The remaining tree nests were in western juniper trees in southern Franklin Co. All tree nests were between 3.5 and 7.5 m aboveground. Of the nests found in junipers, all were active. Nests were placed in widely separated trees which formed a savannah around a more densely wooded area.

Ground nests ranged from 76 to 122 cm in diameter and 41 to 122 cm thick. Tree nests ranged from 91 to 107 cm across and 61 to 91 cm thick. Nest bowl diameters were approximately the same for ground and tree nests: 30 to 38 cm in diameter and 8 to 15 cm deep.

All nests were composed largely of big sagebrush (*Artemisia tridentata*) and rabbitbrush (*Chrysothamnus* sp.) limbs ranging in size from 0.5 to 5 cm in diameter. Although juniper limbs were present in the juniper tree nests, they were never abundant. All nest bowls were lined with strips of freshly peeled sagebrush bark and blades of perennial bunchgrass (*Agropyron spicatum*, *Poa* sp., and *Festuca* sp.). Varying quantities of cow dung and dead roots of bunchgrass were present in most nests.

NEST SUCCESS AND DENSITY

In 1974, we found 23 nest sites: 9 were active and 14 were inactive. In all but one case, nests were built on rock outcrops. Five young were fledged from the nine active nests on rock outcrops for a success of 0.55. Six nests produced no young.

In 1975, we found eight new nest sites—three on rock outcrops and five in juniper trees. One of the outcrop nest sites and all juniper nest sites were active. The outcrop nest site was not successful, but four, and perhaps five juniper nest sites were. The juniper nest site with questionable success was found after young would have fledged. The nest proper was not found, but both adults defended the territory.

We re-examined 13 of the 1974 nests in 1975. Six were active in both 1974 and 1975, but only one was successful in both years (two young fledged in 1974 and four in 1975). The juniper nests fledged a total of at least 11 young for a nesting success of 2.2 young per nest.

FOOD HABITS

The most frequently consumed prey item in scabland and juniper habitats was the northern pocket gopher (*Thomomys talpoides*) (Table 1). It comprised 37% of the prey items in the scabland habitat and 19% of the prey items in the juniper habitat.

Birds also were frequently consumed. The Western Meadowlark (*Sturnella neglecta*) was the most abundant small bird taken at both sites. Lagomorphs and insects were frequent prey items at the scabland nest, while snakes were seldom preyed on. However, the green racer (*Coluber constrictor*) and bullsnake (*Pituophis melanoleucus*) together constituted the second most fre-

TABLE 1. Diet of the Ferruginous Hawk in Washington during the nesting season, 1975.

Species	Juniper nest site		Washtucna scabland nest site	
	Number individuals	Percent individuals	Number individuals	Percent individuals
SMALL MAMMALS		39		38
Pocket gopher (*Thomomys talpoides*)	21	19	19	37
Pocket mouse (*Perognathus parvus*)	4	4	1	2
Ground squirrel (*Citellus washingtoni*)	16	15		
Ord's kangaroo rat (*Dipodomys ordi*)	1	1		
LAGOMORPHS		6		14
Black-tailed jackrabbit (*Lepus californicus*)	1	1	4	8
Desert cottontail (*Sylvilagus nuttali*)	5	5	3	6
BIRDS		17		23
Western Meadowlark (*Sturnella neglecta*)	13	12	9	17
Long-billed Curlew (*Numenius americanus*)	1	1	3	6
Black-billed Magpie (*Pica pica*)	1	1		
Horned Lark (*Eremophila alpestris*)	1	1		
Ring-necked Pheasant (*Phasianus colchicus*)	1	1		
Burrowing Owl (*Athene cunicularia*)	1	1		
SNAKES		34		4
Yellow-bellied racer (*Coluber constrictor*)	21	19	1	2
Bullsnake (*Pituophis melanoleucus*)	16	15	1	2
INSECTS				
Carabidae, Tenebrionidae, Orthoptera, and Elateridae	6	6	11	21

quently consumed prey group in the juniper habitat. The observed variations in diets are probably related to differences in abundance, distribution, and diversity of prey species, and perhaps to different hunting methods among individual Ferruginous Hawks.

PLUMAGES

Bowles and Decker (1931) indicated that only the light plumage phase is characteristic of Washington Ferruginous Hawks. In 1975, one nest in a juniper fledged two dark-phase birds and contained one dead dark-phase individual, approximately 5 weeks old. These were the only melanistic birds we found.

DISCUSSION

NESTS AND NEST SITES

The nests we found resembled those described by Weston (1969), Bowles and Decker (1931), Olendorff (1973), Smith and Murphy (1973), and Angell (1969). Bowles and Decker (1931) mentioned that nests invariably had some hard foreign substance lying loose in the nest with the eggs: "This is most often a ball of horse or cow droppings, often as large as two clenched fists and usually hardened by time." We also found such a ball in many Ferruginous Hawk nests. The dung disintegrated and formed a matted carpet over the nest surface as nestlings grew.

NESTING SUCCESS AND DENSITY

Weston (1969) in Utah, Howard and Wolfe (1976) in northern Utah and southern Idaho, and Olendorff (1973) in Colorado reported percentages of reproducing pairs and numbers of young fledged per pair present that were similar to ours (Table 2). However, Smith and Murphy (1973) in Utah found higher percentages of reproducing pairs, which may be due to the small size of their study area (207 km^2) and the chance selection of a quality site (availability of nest sites and high prey density). Bowles and Decker (1931) mentioned that many canyons, large outcrops of rock, and trees contained the remains of nests. They implied that few nests were active and speculated that Ferruginous Hawks were formerly much more numerous. Weston (1969) found many unoccupied sites containing old nests in poor condition. He also noted that many active Ferruginous Hawk nests occurred in specific parts of a larger region, while nearly identical portions of the same region contained only old, inactive nests. We noted the same situation, finding five active ground nests and five active tree nests in Franklin Co., while in other counties, apparently identical ground nesting areas contained only old, inactive nests. The active nests occurred in the same general areas during both years of our study. Smith

TABLE 2. Nesting and fledging success of Ferruginous Hawks in North America.[a]

Location	No. active pairs	No. successful nests	% reproducing pairs	No. fledged/ nest
Utah (Weston 1969), 837 km²				
1967	21	13	0.62	0.67
1968	21	14	0.67	2.00
Utah (Smith and Murphy 1973), 207 km²				
1967	8	8	1.00	1.16
1968	10	9	0.90	2.11
1969	13	12	0.92	2.66
1970	9	7	0.78	1.43
Colorado (Olendorff 1973), 1,072 km²				
1971	10	7	0.70	2.29
1972	6	3	0.50	2.67
Washington, 38,850 km²				
1974	9	3	0.33	1.80
1975	12	6	0.50	2.50
Northern Utah and southern Idaho (Howard and Wolfe 1976), 2,800 km²				
1972	43	31	0.72	1.9
1973	54	26	0.48	1.0

[a] The area values indicate the number of square kilometers involved in each study.

and Murphy (1973) supplied one possible explanation for this phenomenon. They stated that Ferruginous Hawks choose to nest near their food supply, thereby lessening the problem of procuring adequate food for their large broods. We did not collect data on prey abundance and cannot, therefore, determine if this situation existed in our study area. The combined 1974 and 1975 nesting surveys encompassed almost all the available nesting habitat for Ferruginous Hawks in Washington. These data indicate that no less than 15 pairs nested in Washington—10 ground nesters and 5 tree nesters. Since one-half of the juniper forest area in Franklin Co. has not been examined, due to inaccessibility, additional tree-nesting pairs may be present. Overall, we believe that Washington's present population of Ferruginous Hawks consists of about 20 nesting pairs. If nesting success continues at a level similar to that in 1974 and 1975, we can expect 12 or 13 of these to produce young.

The important factors presently impinging on Ferruginous Hawk productivity apparently are: (1) Tree nests have an advantage of placing nests out of reach of ground predators. Predators (mammalian and avian) are suspected in the failure of two ground nests in 1974 and one nest in 1975. In these cases, eggshells were found near the nest sites. (2) Tree nests were always far removed from regular human disturbance. Human acts caused two ground nest failures in 1974. In one instance, an adult female was killed on the nest with two partially incubated eggs beneath her, the cause of death being gunshot wounds. The other nest failure was due to desertion caused by visiting the nest too early in the season.

FOOD HABITS

Our analysis of food habits differs from other published accounts in certain respects. Smith and Murphy (1973) noted that mammals comprised 90% of prey individuals, lagomorphs being the most frequent prey items (averaging 68% of the total prey consumed). Birds comprised 9% and reptiles 2% of the total prey items. Weston (1969) reported that Ferruginous Hawks consumed 92% mammals with black-tailed jackrabbits (*Lepus californicus*) and kangaroo rats (*Dipodomys* sp.) comprising 48% and 33%, respectively. Birds formed 5% and reptiles 3% of the individuals eaten. Olendorff (1973) reported that 76% of the prey items were mammals, primarily thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) and lagomorphs (*Lepus* and *Sylvilagus*). Birds totalled 24% and reptiles were not noted. Howard and Wolfe (1976) found 84% of Ferruginous Hawk prey dominated by mammals, primarily black-tailed jackrabbits. Birds formed 6.5% of the diet and reptiles 8.6%. Insects were not reported in any of the previously mentioned dietary studies. These data strongly indicate an association between Ferruginous Hawk nesting and black-tailed jackrabbits. Smith and Murphy (1973), Woffinden (1975), and Howard and Wolfe (1976) all stated that Ferruginous Hawks depend on a high density of prey, primarily black-tailed jackrabbits, in order to nest and successfully raise young to fledging. Woffinden (1975) and Howard and Wolfe (1976) implied, however, that Ferruginous Hawks will successfully nest if the abundance of other prey is commensurate with a reduction of jackrabbits. We decline to draw any firm conclusions from our limited amount of food habits data (two pairs of birds), but we speculate that snakes at the juniper area are sufficiently numerous to supply the Ferruginous Hawks with enough prey to sustain reproduction. The channeled scablands may not contain an adequate prey base to support nesting hawks.

SUMMARY

Ferruginous Hawks in Washington nest only in the steppe region of the southeastern part of the state. Nests are placed either on basalt

outcrops on the slopes of hillsides and canyons, or in the canopy of juniper trees. A survey of the available nesting habitat revealed that no fewer than 15 and perhaps 20 pairs of adult birds breed in the state. Of these, 12 or 13 pairs will probably produce young each year. Dark-phase individuals are reported for the first time for Washington.

Diet analysis showed that small animals (pocket gophers and ground squirrels) were the most frequently consumed prey items. Small birds, primarily meadowlarks, were also eaten by both ground and tree nesters. Insects and lagomorphs were fairly abundant as prey items at a ground nest, while snakes (yellow-bellied racer and bullsnake) seemed to replace them in importance at a juniper nesting site.

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