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THE STATUS AND NESTING OF FERRUGINOUS HAWKS (*BUTEO REGALIS*) IN WASHINGTON

R. E. Fitzner, L. L. Boyd, Don Berry and Carrol Rieck

Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

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DISCLAIMER

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INTRODUCTION

The first published account dealing with the biology of the Ferruginous Hawk (Buteo regalis) in Washington was conducted by Bowles and Decker (1931). Their efforts were directed toward describing nests, eggs, food habits, intra-specific relationships, and habitat utilization. There are no other comprehensive studies dealing with the status and biology of Washington's Ferruginous Hawk population. There is a paucity of information concerning this species, throughout its range in North America. The only substantiative information on regional populations was published by Olendorff (1973) in Colorado, Weston (1969) in Utah, and Smith and Murphy (1973) in Utah. The lack of information on Ferrugionous Hawks has prompted the U.S. Fish and Wildlife Service (1973) to place this species on their "Status Undetermined" list, suggesting that it may possibly be threatened with extinction. The intent of this study was to provide baseline data on current population levels in Washington and to describe various facets of their biology (diet and nest site selection) which may influence productivity. Comparisons were made with other studies to identify factors influencing North American populations.

STUDY AREA

The study area comprised 15,000 square miles (Fig. 1), extending over 12 counting in southeastern Washington, excluding the Blue Mountains. The study area has been classified as shrub-steppe (Daubenmire, 1970) and lies in the rainshadow of the Cascade Mountains. This region occupies a basin that is encircled by forest-covered mountains. Most of the native vegetation has been destroyed by cultivation, water impoundment, or modified by fire and grazing. Much of the area is channeled scabland, formed when glacial floods bared large tracks of basalt, and scoured canyons and deep valleys (Fig. 2) (United States Department of Interior, 1973). A small portion of the study area, 29,000 acres in Southern Franklin County, consists of glacio-fluvial deposits of sand. The unique feature of this area is the presence of Western Juniper trees (Juniperus occidentalis) which forms savannahs of variable size, separated by tracts of moving sand dunes (Fig. 3). The climate in the study area is characterized by moderately cold winters and hot summers. The mean of the coldest month is between -5.5 and 1.5°C, while the mean of the hottest month is between 18.5 and 24.5°C (Daubenmire, 1970). Precipitation generally occurs during the fall and winter months.

METHODS

Nest sites[1/] were located by direct observation and by observing adult hawks soaring or carrying nesting material. A site was considered active if a pair of Ferruginous hawks were present and if there was evidence of nest building activity that year. In 1974, searches for nests were conducted

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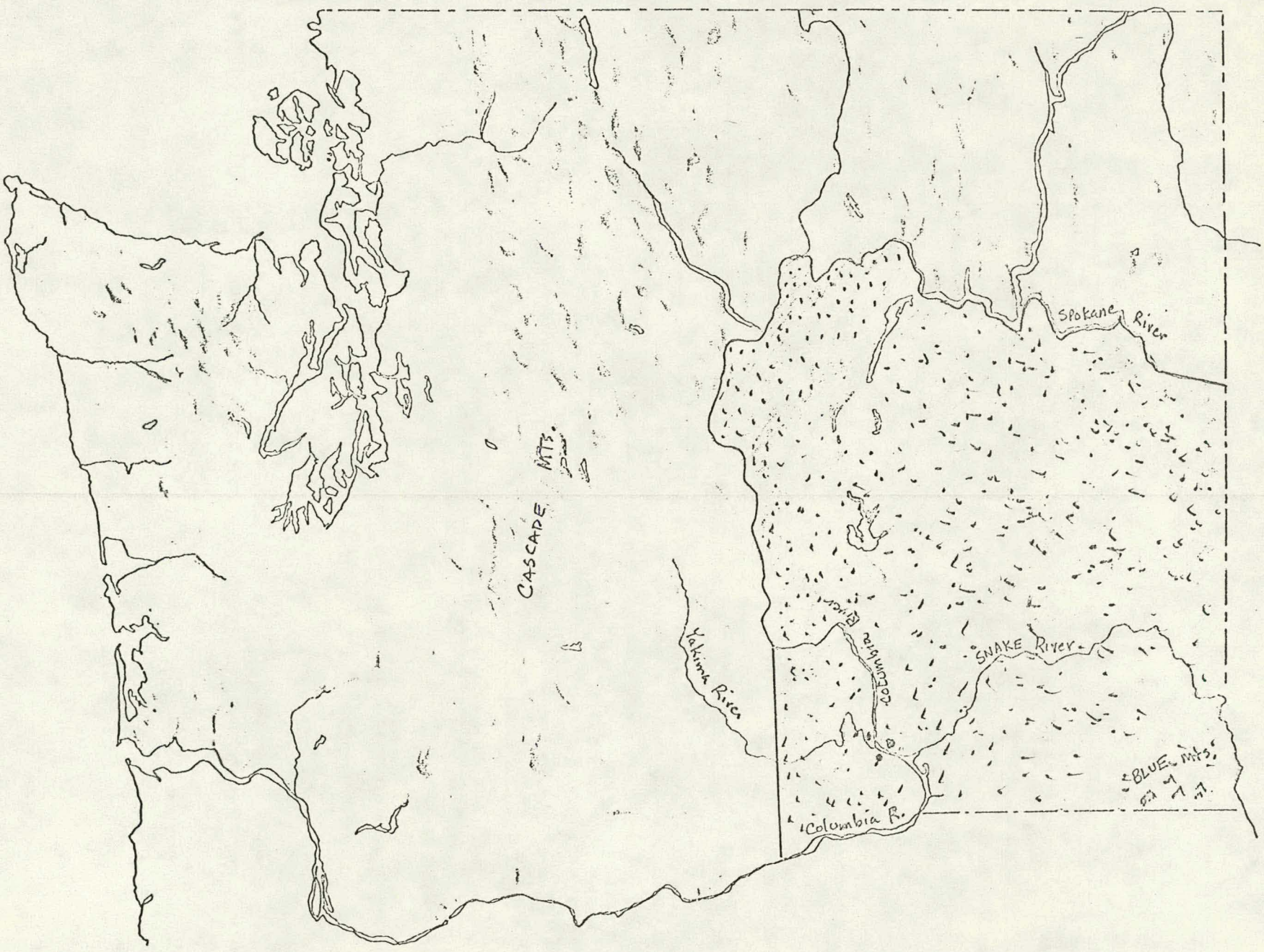
[1/] The term nest site is used to denote the nesting territory—more than one nest may be present, but only one will be used for egg laying at a time.

Fig 1.

Study Area, 15000 sq mi.



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Washtucna

in April, May, June, and July. In 1975, nest searching was conducted in June, July, and August. Automobile, fix winged single engine aircraft, boat, and walking were used in the survey. The nesting materials used and measurements of nest size were recorded for all tree nests and eight of the ground nests.

Food habits were determined during the nesting season of 1975 by tabulation of prey items and analysis of pellets gathered from two nests—one ground nest located in the channeled scabland near Washtucna and a Juniper tree nest in Southern Franklin County. Pellets were soaked in water until they could easily be pulled apart and prey items identified. Identification of prey species was based on comparison with specimens collected from areas near nest sites and from study specimens housed in the Washington State University, Connor Museum. We followed techniques described by Errington (1932), Moon (1949), Mayer (1942), and Giles (1970).

Relative percent frequency estimates were calculated from each prey taxa on the basis of total number identified. Relative frequency according to Curtis (1950) is the frequency value of a given species divided by the total of the frequency values for all species, i.e.,

$$\text{Relative Frequency of Species A} = \frac{\text{Frequency of Species A}}{\text{Sum of Frequency Values for All Species}} \times 100$$

RESULTS

Description of Nests and Nesting Sites

Thirty-two nest sites and seventy-one nests were located during 1974 and 1975. Twenty-five sites contained a total of sixty-five nests, which

were located on the ground. The Ferruginous Hawk's territory usually contains more than one nest; one site had eight. The adults may refurbish one or more nests used in prior years or may construct a new one. They often build nests on a basaltic rock shelf or outcropping located on hillsides or in canyons (Fig. 4). No nests were found on flat ground.

Six nests were located in trees. One of these was located in Benton County and was situated in a locust tree (Robinia pseudacacia). The nest was not used during either the 1974 or 1975 survey, but an active Swainson's Hawk (Buteo swainsoni) nest was built adjacent to it. The remaining tree nests were all located in Western Juniper trees (Juniperus occidentalis) in Franklin County (Fig. 5). All tree nests were located between 12 and 25 feet aboveground. The juniper nesting situation was unique in that all nests were active. The nesting area consisted of widely separated trees which formed a savannah around a dense woodland.

Ground nests ranged from 2.5 to 4 feet in diameter and 16 inches to 4 feet thick. The tree nests ranged from 3 to 3.5 feet across and 2 to 3 feet thick. Brooding pocket diameters were approximately the same for ground and tree nests and ranged from 12 to 15 inches in diameter and had a depth of 3 to 6 inches.

Both ground and tree nests were composed largely of big sagebrush (Artemisia tridentata) and rabbitbrush (Chrysothamnus sp.) limbs from 0.25 inches to 2 inches in diameter. Juniper limbs were often present in the Juniper tree nests, but were never abundant. All nest bowls were lined with strips of freshly pealed big sagebrush bark and blades of perennial bunchgrasses (Agropyron spicatum, Poa sp., and Festuca sp.). Varying quantities of cattle dung and dead roots of perennial bunchgrasses were present in most nests.

Nesting Success and Density

In 1974, we found 23 Ferruginous Hawk nest sites. Of these, 9 were considered active and 14 were inactive. Three nests succeeded in producing a total of five fledglings. Fledging success was 0.55 young per active nest. Of the 23 nest sites, only one was located in a tree; all others were built on the ground, generally on an outcropping of basalt rock situated on the slope of a hillside or canyon wall.

In 1975, eight additional nest sites were located—three on rock outcroppings and five in Juniper trees. One of the ground nest sites and all Juniper nest sites were active. The ground nesting situations did not produce young, but four, and perhaps all, Juniper nests did.[2/] Thirteen of the nests examined in 1974 were re-examined in 1975. Six of these nests were active in 1974 and 1975 and one nest was consistent in fledging young (two were fledged in 1974 and four were fledged in 1975). All Juniper nests fledged no less than 11 young. 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 five tree nesters. Considering that 1/2 of the Juniper forest area in Franklin County has not been examined (due to inaccessibility), there is a chance additional tree nesting pairs may be present. Overall, we believe that Washington's present Ferruginous Hawk population consists of about 20 nesting pairs. If nesting success continues at a level similar to 1974 and 1975, we can expect 12 or 13 of these to produce about 32 young per year.

[2/] The nest site of questionable status was found after young would have fledged. The nest proper was not found, but both adults defended the territory.

Food Habits

The most frequently consumed prey in both areas was the Northern Pocket Gopher (*Thomomys talpoides*). It comprised 37% and 19% of prey items from the Washtucna and Juniper areas, respectively (Table 1). This species is primarily subterranian, but may forage aboveground in spring and summer, increasing susceptibility to predators (Barnes, 1973). Dispersing juveniles are most vulnerable to predation, since they have no established burrow system and sometimes travel aboveground (Howard and Childs, 1959). Meadowlarks were also frequently consumed and were the most abundant small bird at both sites. Lagomorphs and insects were frequent prey at the Washtucna ground nesting site while snakes were seldom preyed on. The two snake species, *Coluber constrictor* and *Pituophis melanolucus*, when combined. constituted the second most frequently consumed prey group in the Juniper area, while Lagomorphs and insects played minor roles. The observed variations in prey frequency are probably related to differences in prey abundance, distribution and diversity between areas, and perhaps to variations in hunting strategies among Ferruginous Hawks.

Plumages

Bowles and Decker (1943) indicate that only the light plumage phase is characteristic of Washington Ferruginous Hawks. In 1975, one nest in a Juniper tree fledged two dark phase birds. One other dark phase juvenile approximately five weeks old was found dead at the nest. These were the only birds of the melanistic color phase observed in the study area.

Table 1. Diet of the Ferruginous Hawk in Washington during the nesting season.

Species	Number Individuals	% Individuals
---------- Washtucna Nest Site ----------		
Small Mammals		38
Pocket gopher (*Thomomys talpoides*)	19	37
Pocket mouse (*Perognathus parvus*)	1	2
Lagomorphs		13
Black-tailed hare (*Lepus californicus*)	4	8
Desert cottontail (*Sylvilagus nuttali*)	3	6
Birds		23
Meadowlark (*Sturnella neglecta*)	9	17
Long-billed curlew (*Numenius americanus*)	3	6
Snakes		4
Yellow bellied racer (*Coluber constrictor*)	1	2
Bullsnake (*Pituophis melanoleucus*)	1	2
Insects		
(Carabidae, Tenebrionidae, Orthoptera, Elateridae)	11	21

Table 1 (Continued)

Species	Number Individuals	% Individuals
---------- Juniper Nest Site ----------		
Small Mammals		38
Pocket gopher (Thomomys talpoides)	21	19
Pocket mouse (Perognathus parvus)	4	4
Ground squirrel (Citellus washingtoni)	16	14
Kangaroo rat (Dipodomys ordi)	1	1
Lagomorphs		5
Black-tailed hare (Lepus californicus)	1	1
Desert cottontail (Sylvilagus nuttali)	5	5
Birds		17
Meadowlark (Sturnella neglecta)	13	12
Long-billed curlew (Numenius americanus)	1	1
Black-billed magpie (Pica pica)	1	1
Horned lark (Eremophila alpestris)	1	1
Ring-necked pheasant (Phasianus colchicus)	1	1
Burrowing owl (Speotyto cunicularis)	1	1
Snakes		33
Yellow-bellied racer (Coluber constrictor)	21	19
Bullsnake (Pituophis melanoleucus)	16	14
Insects		
(Tenebrionidae, Orthoptera)	6	5

DISCUSSION

Nests and Nest Sites

Weston (1969), Olendorff (1973), Smith and Murphy (1973), and Angell (1969) found Ferruginous nests that were not unlike those herein reported. Bowles and Decker (1931) also report Ferruginous nests in Washington to be similar to ours. They 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 clinched fists and usually hardened by time." We did not observe this in any Ferruginous nests.

Nesting Success and Density

Weston (1969) and Olendorff (1973) report percentages of reproducing pairs and numbers of young fledged per pairs present, which were similar to ours (Table 2). Smith and Murphy (1973) report rather high percentages of reproducing pairs which may be due to the small size of their study area (80 sq. mi.) and the selection of a site which provided a preferred habitat for Ferruginous Hawks. Bowles and Decker (1931) did not quantatively report on the number and successes of nests in Washington, but did mention that many canyons, large outcroppings of rock, and trees showed remains of nests. He implied that the number of active nests was small and speculated that at some earlier date Ferruginous Hawks were numerous. Weston (1969) found many unoccupied nest sites containing old nests in poor condition. He noted that many active Ferruginous nests occurred in a specific region. The same phenomena was observed during

Table 2. Nesting and Fledging Success of Ferruginous Hawks in North America

	No. Pairs	No. Nesting	% Reproducing Pairs	No. Fledged/ Nest
Utah (Weston) *323				
1967	21	13	0.68	0.67
1968	21	14	0.67	2.00
Utah (Smith and Murphy) *80				
1967	8	8	1.00	1.16
1968	10	9	0.90	2.11
1969	13	12	0.92	2.66
1970	9	7	0.77	1.43
Colorado (Olendorff) *414				
1971	10	7	0.70	2.29
1972	6	3	0.50	2.67
Washington *15000				
1974	9	3	0.33	1.66
1975	12	6	0.50	2.50

*Indicates the number of square miles involved in each study.

Table 3. Ferruginous Hawk Nesting Success in Washington

Year	Ground Nests			Tree Nests		
	Active	Successful	S/A	Active	Successful	S/A
1974	9	3	0.33	0	0	
1975	6 (10)*	1 (3)	0.16 (0.27)	5 (5)	4 (5)	0.80 (1.00)

*Bracketed values represent a combination of 1974 and 1975 data, i.e., all active nests and successful nests examined during both years were presumed unchanged in status and a tree nests examined after the nesting season was presumed successful.

this study—we found five active ground nests and five active tree nests in Franklin County. In other countries, identical ground nesting areas contained only old inactive nests. The active nests occurred in the same general areas during both years of our study.

The factors which influence the distribution patterns of the Ferruginous Hawk are presently unclear, but several authors have made suggestions. Smith and Murphy (1973) state that the choice of nesting sites by Ferruginous Hawks depends on the availability of Lagomorphs, which are dependent on suitable vegetational and topographical features for their existence. Olendorff (1973) also reflects on the importance of Lagomorphs, but further mentions that the destruction of habitat through cultivation may have caused a shift from ground and cliff nesting to tree nesting, without causing a change in Ferruginous population levels.

During pre-Caucasian times, the ground nesting situation may have prevailed. The habitat was then little disturbed by grazing and cultivation and prey populations were probably abundant, diverse, and widely distributed. The Ferruginous Hawk may then have been dispersed over most of the arid steppe region. Today, the environment has become more heterogeneous. Parameters affecting nesting success have changed with a resultant change in the dispersal pattern of Ferruginous Hawks. The population existing in early times may now be broken up into sub-populations which exist in areas where suitable habitat remains. These areas of suitable habitat are separated and therefore subject the Ferruginous sub-populations to different environmental conditions which can alter reproductive performance. At any point in time, some areas may be unoccupied, some will have a few pairs, and some will contain relatively

dense populations. Andrewartha and Birch (1954) discuss the operation of this type of system and reflect on the importance of dispersal between subpopulations as a necessary mechanism for dampening fluctuations in total population size. In our study we were impressed by the extreme differences in these so-called subpopulations of Ferruginous Hawks. We noted that there were two areas with markedly different ratios in nesting success. One population of birds, the Juniper nesters, approach a nesting success of 100%, while ground nesters in other regions did not exceed a 33% success ratio (Table 3). Perhaps the tree nesting situation is in effect dampening the low nest success ratio in outlying areas. At present, the Juniper area may be serving as the nucleus for Washington's Ferruginous population. The birds produced here may disperse to other areas where they will be subjected to a differing set of environmental factors affecting their productivity. In time, the parameters affecting the various subpopulations of Ferruginous Hawks may change. If the environmental factors become unfavorable throughout the entire range, then the eventual extirpation of the bird may result. The important factors which we feel are presently impinging on ground and tree nesting Ferruginous Hawk productivity are these: (1) Tree nests have the obvious advantage of placing nests out of reach of ground predators and livestock. Predators (mammalian and avian) are suspect in the failure of two ground nests in 1974 and one nest in 1975. In these cases, egg shells were found near the nest sites. (2) Tree nests were far removed from human disturbance. Human disturbance caused at least two ground nest failures in 1974. In one instance, the adult female was shot dead on the nest with two partially incubated eggs beneath her. The other

nest failure was caused by observers visiting the nest early in the season. (3) Prey may have been more abundant, diverse, and available in the moderately grazed Juniper grasslands habitat.

Food Habits

In comparing our analysis of food habits with our published accounts, we find some interesting differences. Smith and Murphy (1973) noted that mammals comprised 90% of prey individuals, Lagomorphs being the most frequent prey items, averaging 63% of the total prey consumed. Birds comprised 9% of the total prey items, while reptiles 2% of the total prey individuals. Weston (1969) reported that Ferruginous Hawks consumed 92% mammals with black-tailed hares and kangaroo rats comprising 48% and 33% of the mammals, respectively. Birds formed 5% and reptiles 3% of the individuals eaten. Olendorff (1973) reported 76% of the prey items consisting of mammals, primarily thirteen lined ground squirrels and Lagomorphs. Birds totalled 24% and reptiles were not eaten. Insects were not reported in any of the previously mentioned dietary studies.

We previously indicated that Smith and Murphy (1973) and Olendorff (1973) attribute the nesting success and distribution of Ferruginous Hawks partially to the abundance of Lagomorphs and small mammals. Smith and Murphy's data on diet and percentages of reproducing pairs would tend to support such an hypothesis, while Olendorff's (1973) and Weston's (1969) similar dietary data, but smaller percentages of reproducing pairs, would not. This would infer that a diet of Lagomorphs may not be of major importance for Ferruginous Hawk productivity.

We were unable to quantitate prey densities at the two nesting areas, but from a qualitative approach, we felt that the prey consumed were representative of their occurrence in the different habitats and Ferruginous Hawks are somewhat opportunistic in prey selection. Lagomorphs were not plentiful at either site, but small mammals, birds, and snakes were abundant and apparently supplied the Ferruginous Hawks with an adequate diet. A low percentage of reproducing pairs may be an indication that there are regional inadequacies in prey levels, which tend to concentrate nesting pairs in areas where prey are available and abundant. Perhaps the non-reproducing pairs are located in areas where prey levels are sufficient for adult survival but inadequate for nestling. There may be a built-in physiological mechanism which triggers the adults to nest when prey levels are abundant and to abstain when they are low. The successful pairs would be limited to regions where all nesting requirements were met, especially food. The fledging success reported in this study is indicative that Lagomorphs may be supplemented by other prey species without adversely effecting nesting success. The high productivity of Juniper nests appears to support this argument. In this case, the productivity of the population may be limited by the minimum interspecific (nearest neighbor) nesting site distances.

SUMMARY

Nesting of Ferruginous Hawks in Washington is confined to the shrub-steppe region in the eastern part of the state. The birds nest in two entirely different situations, either on outcroppings of basalt on the slopes of hillsides and canyons, or on the canopy of Juniper trees. Nests dimensions and materials are described. A nearly complete survey of all available nesting habitat in the state revealed that no fewer than 15 and perhaps 20 pair of adult birds breed in the state. Of these, we expect that 12 or 13 pairs will produce young each year.

Dietary analysis revealed that small mammals (pocket gophers and ground squirrels) were the most frequently consumed prey items. Small birds, primarily meadowlarks, were frequently consumed prey 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.

Dark phase Ferruginous Hawks are reported for the first time in Washington State.

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Present Address of R. E. Fitzner is Ecosystems Department, Battelle-Northwest, Richland, WA.