FERRUGINOUS HAWK NESTING ECOLOGY AND RAPTOR POPULATIONS IN NORTHERN SOUTH DAKOTA

JOHN T. LOKEMOEN
AND
HAROLD F. DUEBBERT

Studies of raptors have increased recently because some species have shown serious population declines (Ratcliffe 1967, Hickey 1969). Information on population dynamics and breeding biology of raptors in southwestern United States has been reported by Weston (1968), Platt (1971), and Smith and Murphy (1973), but except for the study of Olendorff (1973) little data have been published on raptor populations in the northern Great Plains since the early 1900's. This paper presents data on the ecology of the Ferruginous Hawk (*Buteo regalis*) with notes on other raptors in McPherson County, in northcentral South Dakota during 1973 and 1974.

STUDY AREA AND METHODS

The study area (fig. 1) contained 269 km², extended approximately 21 km north and south and 13 km east and west, and the northeast corner was about 1 km west of Long Lake, South Dakota. The entire area is within the Coteau du Missouri, a rolling, glacial formation containing numerous small wetlands and a few permanent lakes (Flint 1955). A sample of 11 randomly selected square miles (total of 28.49 km²) within the study area indicated the following habitat types: native mixed-grass prairie pastures, 31%; wetlands, 13%; cropland, 25%; and tame hay and pasture, 29%. Woodlands are limited to 0.3% of the area occurring mainly as shelterbelts near farmsteads. There are no steep ravines or prominent buttes.

The area has a midcontinental climate with long, cold winters and short, warm summers. At Eureka, which is located 19 km west, the average annual January temperature is −12.3°C and the average annual July temperature is 21.6°C (U.S. Dept. Commerce 1974). The average annual precipitation is 43.3 cm. Strong winds are common throughout the year, and thunderstorms are a normal summer phenomenon.

The native grasslands are part of the mixed-grass prairie zone. Little bluestem (*Andropogon scoparius*), prairie junegrass (*Koeleria cristata*), green needlegrass (*Stipa viridula*), and Kentucky bluegrass (*Poa pratensis*) are common upland grasses. Needleleaf sedge (*Carex eleocharis*) and yellow sedge (*Carex pennsylvanica*) are also common in the uplands. Prairie forbs are numerous and include pasque flower (*Anemone patens*), stiff goldenrod (*Solidago rigida*) and purple coneflower (*Brauneria angustifolia*). Trees are primarily box-elders (*Acer negundo*) and cottonwoods (*Populus deltoides*); shrubs are uncommon. The area is entirely rural and lightly populated with an occupied farmstead for each 6 km² on the average. Small grain farming and livestock grazing are the principal land uses.

The study was conducted from April through August in 1973 and 1974. During the spring, we spent several days on the area each week to note raptor activities and to search for nests. Nests were located by driving or walking to high points and carefully observing with 7 × 35 binoculars and a 20× telescope. All trees were checked for nests before the leaves appeared. Active nests of the large birds of prey were verified by observing eggs, young or continued incubation at the nest. For Marsh Hawks (*Circus cyaneus*) and Burrowing Owls (*Speotyto cunicularia*), we assumed that pairs repeatedly seen in one location represented breeding birds.

Food habits of Ferruginous Hawks were determined by identifying prey remains found in nests and in cast pellets found mainly at perching sites (Korschgen 1969). For each ground nest we noted size of the structure, slope exposure, surrounding land use, and dominant surrounding vegetation. Percent composition of nest materials was estimated visually. Where possible, similar measurements were made at tree nests; also height of the nest and species of tree were noted. During 1974 a mirror on an extendable pole was used to observe eggs and young in tree nests. Some additional clutch size data were obtained from nests adjacent to the study area.

To determine if nests were placed in locations away from human activities, we computed the mean distance between each nest and the nearest active farmstead or road. These means were compared with the means between 225 randomly selected points and the nearest active farmstead or road. To analyze whether specific nest sites were selected, the land use within 1.6 km of each nest was compared with the land use on randomly selected square-mile blocks. A circle 1.6 km in radius approximates the size of the Ferruginous Hawk home range as determined by Smith and Murphy (1973).

RESULTS AND DISCUSSION

POPULATIONS

The study area contained 26 raptor pairs in 1973 and 22 pairs in 1974 (table 1); 31 of the 48 total pairs were Ferruginous Hawks and five other raptor species—Red-tailed Hawks (*Buteo jamaicensis*), Swainson's Hawks (*B. swainsoni*), Marsh Hawks, Great Horned Owls (*Bubo virginianus*), and Burrowing Owls—were represented. The Ferruginous Hawk density averaged one pair per 17.4 km² for the 2 years combined. Considering all raptor species, there was one pair per 10.3 km² in 1973 and one per 12.2 km² in 1974. The adult raptor biomass was calculated as 246 gm/km²

The Condor 78:464–470, 1976

FIGURE 1. A view of the study area showing the rolling topography with prairie grasslands and cropland on the uplands and wetlands in the low areas.

in 1973 and 240 gm/km^2 in 1974 using average weights given by Olendorff (1973).

The density of Ferruginous Hawks exceeds that found by other investigators. Weston (1968), whose study was conducted in desert and semi-desert of Utah, found one pair for each 39.9 km^2 on the general study area. He found one pair per 18.1 km^2 on a smaller 220 km^2 area chosen because it had a high density of Ferruginous Hawks. Platt (1971) found one pair per 116.6 km^2 of desert in Utah. On a 207 km^2 tract in Utah, Smith and Murphy (1973) found one pair on each 20.7 km^2. In Colorado, Olendorff (1973) located a pair on each 99.9 km^2 on a 2598 km^2 area. A total density of one pair of raptors per 5.1 km^2 in Utah (Smith and Murphy 1973) was twice that on our study area. In Colorado shortgrass prairie, Olendorff (1973) found one pair per 16.4 km.^{2}

The Ferruginous Hawk density found on this study area probably indicates the population existing on some 4000 km^2 of adjacent Coteau du Missouri habitat in northern South Dakota. Stewart (1976) stated that the adjacent Coteau region in North Dakota contains the highest densities in that state. The local environment provides the proper habitat conditions for Ferruginous Hawks but lacks the requirements needed by many other species.

SEASONAL CHRONOLOGY

Ferruginous Hawks arrived on the area in late March or early April. Nesting began in mid-April and the first eggs were seen on 12 April 1973 and 17 April 1974. The first eggs hatched in mid-May and young began to fly from the nests in late June. Eggs in most nests hatched in late May and the young began to fly in mid-July. A few Ferruginous Hawks winter in Utah and Colorado, but most return in late February or early March (Smith and Murphy 1973, Olendorff 1973). This is approximately a month earlier than they appeared on our study area. The first eggs were noted in Colorado (Olendorff 1973) on 6 April and 16 April, and in Utah in early to mid-April (Platt 1971, Smith and Murphy 1973). These egg dates are about the same or only a

TABLE 1. Raptor nesting populations on the 269 km² study area in 1973 and 1974.

Species	No. pairs		No. pairs with eggs	
	1973	1974	1973	1974
Red-tailed Hawk	1	1	1	1
Swainson's Hawk	2	0	2	0
Ferruginous Hawk	16	15	15	12
Marsh Hawk[a]	5	2	—	—
Great Horned Owl	1	4	1	3
Burrowing Owl[a]	1	0	—	—
Total[b]	26	22	19	16

[a] Populations of these species were estimated from sightings of resident pairs.
[b] Numbers given for pairs with eggs are minimal, since data are incomplete for Marsh Hawks and Burrowing Owls.

TABLE 2. Percent composition of materials used in nest construction by Ferruginous Hawks. There was no well defined middle layer in tree nests.

Material	Ground nest (n = 12)			Tree nest (n = 5)	
	outside	middle	lining	outside	lining
Sunflowers	38	0	0	25	0
Twigs	37	0	0	62	0
Cowchips	8	23	4	1	0
Sod chunks	0	52	7	0	0
Cattails	2	15	54	3	55
Grass and sedges	0	2	29	0	22
Mosses	0	4	6	0	0
Bark and straw	0	0	0	0	21
Miscellaneous	15	4	0	9	2

week earlier than those found in South Dakota.

Most family groups left the nest site soon after the young were fledged. Some remained in the vicinity of the nest for a month or more. On 26 August 1974, young and one or more adults remained within several hundred meters of two nest sites. One adult flew close to the observer and gave the characteristic scream heard during nest-site defense. Numbers of Ferruginous Hawks gradually decline in late summer; by 7 October 1974 only two adults and one young could be located.

NEST MATERIALS

Nest materials were principally vegetative remains of previous growing seasons. Ground nests were composed of three distinct layers. The largest part was the bulky outer and lower foundation, formed primarily of common sunflower (*Helianthus annuus*) stalks and cottonwood, wild plum (*Prunus americana*), and willow (*Salix* sp.) branches (table 2). Barbed wire, paper, corn stalks, and pieces of plastic were included as minor parts.

A middle nest layer was composed of chunks of prairie sod, "cowchips" and short lengths of broad-leaved cattail (*Typha latifolia*) stalks. This relatively dense portion always remained damp and, combined with the nest lining, created a moist microclimate for the eggs. The nest lining was formed with soft materials including broad-leaved cattail culms, fine grasses, and sedges (*Carex* sp.). The lining was often shaped into a smooth bowl. Outside dimensions of 12 ground nests averaged 102 ± standard deviation of 24.4 cm (range 72–145 cm) by 118 ± 21.4 cm (90–150 cm) with an average depth of 25 ± 4.2 cm (17–32 cm).

The outside structure of tree nests was composed mainly of dead branches and sunflower stalks. Linings contained materials similar to ground nests plus the addition of tree bark and straw. Tree nests contained less material than ground nests, and all material outside the lining in tree nests was considered the outside layer. In late May and early June, green leaves and twigs were added to some of the tree nests. Nests on haystacks were set on top of the hay and little other material was added.

Bent (1937) described tree nests of Ferruginous Hawks that were constructed of heavy sticks, cow dung, and rubbish. Linings were of grass, strips of inner bark, and dead flags (*Phragmites communis*). Weston (1968) found the typical nest to be composed of twigs with a lining of juniper (*Juniperus osteosperma*) bark or bunch grass.

NEST SITES

Three diverse sites were used by Ferruginous Hawks for nest placement; of the nests with eggs, 12 (44%) were on the ground, 13 (48%) in trees, and 2 (7%) on haystacks. Smith and Murphy (1973) found 31% of the nests on the ground and 69% in trees. Weston (1968) found that 52% of the nests were situated on the ground. Olendorff (1973) considered the Ferruginous Hawk as the raptor with the most versatile nesting habits in his study area. He found 69% of the nests in trees, 11% on erosional remnants, 6% on the ground, 6% on cliffs, 6% on creek banks, and 3% on man-made structures. According to Rolfe (1896), typical Ferruginous Hawk nests in pristine North Dakota prairies were placed on the ground, usually on hilltops.

Nests on the ground were always located in prairie in high condition that was unused or lightly grazed. All 13 tree nests were in tall cottonwood trees and averaged 10.4 ± 2.6 m

(range 7.3–14.6 m) above ground. The height of two haystack nests averaged 2.4 m above ground.

Eight of the 12 ground nests were on hilltops and the rest were high on hillslopes; all were oriented toward the west. In northern Utah, Weston (1968) found 55% of the ground nests on east exposures and 23% on south exposures. Nests may be located on certain hillside exposures to allow incubating birds to rise easily into prevailing winds. Wind directions in north-central South Dakota in April are mainly northwesterly, whereas, the prevailing April winds in northern Utah are from the south or southeast (U. S. Dept. Interior 1970).

Lone trees or small, open groves are preferred for nest placement. Five nests were in lone trees and the average number of trees at a nest site was 4.9 ± 4.6 (range 1–13). Smith and Murphy (1973) stated that Ferruginous Hawks avoided dense tree stands and usually nested in lightly wooded regions or on the periphery of the woods.

Each territory contained a waiting or observation site which the pair often used prior to egg incubation. The site was usually located about 50 to 100 m from the nest. Pairs that nested in trees used nearby trees or a hill, but ground-nesting pairs always used nearby hills. These sites commanded a good view of the terrain and were probably used for surveillance of territorial space.

Eleven of 12 ground nests were located further from human activity than the mean distance of randomly selected points. The hypothesis that these two distributions had the same median was rejected (sign test, $P < 0.01$). Conversely, tree nests did not deviate from the random pattern as seven nests were located closer to human activity than expected and six were farther. The eggs in ground nests can be easily disturbed by humans or their domestic animals, whereas this is not the case for tree nests. Ferruginous Hawks respond by constructing nests in trees, or on the ground in places remote from human disturbance.

Ground nests were in areas with a significantly higher (Wilcoxin rank sum test, $P < 0.01$) percentage of prairie than randomly selected square miles. The land use surrounding tree nests was not different from randomly selected units. Figure 2 shows the relationship between the occurrence of ground nests and prairie. Ground nests may be placed on prairie because it is not disturbed by cultivation, and prairie provides the basic requirements of this species such as open space and prey. Tree

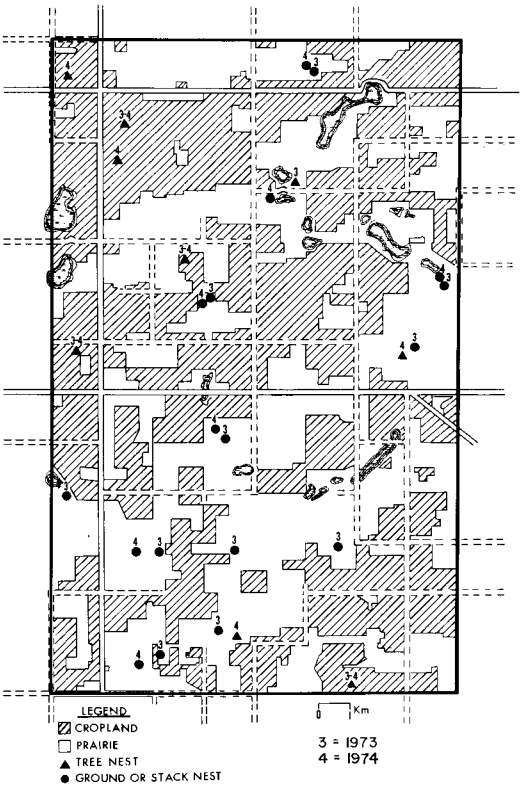

FIGURE 2. Location of Ferruginous Hawk nests on the study area in relation to unplowed prairie and to each other.

nests were not usually located within prairie, but all tree nests were within 1 km of prairie or grasslands. In Colorado, Olendorff (1973) found 58% of the Ferruginous Hawk nests in grassland.

RAPTOR INTERACTIONS

Ferruginous Hawk territories were large and the closest nests were separated by 1.6 km in 1973 and by 1.4 km in 1974. The mean distance between 25 nests where the nearest Ferruginous Hawk nest was known was 2.6 ± 1.0 km (range 1.4–4.7 km) for both years combined. Smith and Murphy (1973) found that nests in their study were similarly separated by 2.5 ± 0.9 km. Four tree nests were used by Ferruginous Hawks in both 1973 and in 1974, and 13 of the Ferruginous Hawk nests built in 1974 were located less than 1 km from a 1973 nest site (fig. 2).

A tree nest used by the lone resident pair of Red-tailed Hawks in 1973 was used by Ferruginous Hawks in 1974, and the only pair of Red-tailed Hawks on the study area nested in a tree 2.3 km east of the 1973 site. In 1974, Swainson's Hawks returned to a grove used successfully by them in 1973. The site was

TABLE 3. Variation in Ferruginous Hawk clutch size.

Nest site	No. eggs in clutch				Average
	3	4	5	6	
Tree	1	7	1	0	4.0
Ground	0	5	4	1	4.6
Haystack	0	2	0	0	4.0
Total	1	14	5	1	4.3

already occupied by a pair of Ferruginous Hawks. The Swainson's Hawks built and abandoned a nest 1.4 km southeast of the grove but finally nested successfully 1.7 km to the north.

In 1974, a pair of Great Horned Owls occupied a tree nest that was used by Ferruginous Hawks the preceding year. During our first visit to this nest on 15 April, a Great Horned Owl was brooding small young in the nest. On 23 April two Great Horned Owls were perched in a tree about 1.5 km north of the nest and a pair of Ferruginous Hawks were sitting in a shelterbelt 100 m away. A broken Ferruginous Hawk egg was found in the shelterbelt. On 30 April the hawks were at the tree site and the nest contained three Ferruginous Hawk eggs. The Great Horned Owls and their progeny had been apparently displaced. No remains of the young owls were found.

PRODUCTIVITY

Average clutch size of 21 complete clutches was 4.3 eggs; 4-egg clutches were the most common (table 3). Tree nest clutches differed significantly from ground nest clutches by containing 0.6 fewer eggs (Wilcoxin rank sum test, $P < 0.05$). Smith and Murphy (1973) found an average clutch size of 3.2 and Olendorff (1973) an average of 3.1. Many of the nests in these studies were in trees or on cliffs; sites that may tend to have fewer eggs than ground nests. Larger clutches may be more common on this study area because of the abundance of food. Lack (1966) presented evidence that Tawny Owls (*Strix aluco*) and Short-eared Owls (*Asio flammeus*) had larger clutches when prey was more abundant.

Hatching success was 63% for the 27 clutches of Ferruginous Hawk eggs. Young were fledged from 59% of the nests. Four pairs either lost the entire clutch before we observed it or the female did not lay eggs. Hatching success was probably depressed by our disturbance which may have caused abandonment of nests that were later destroyed by predators. An average of 2.1 young were hatched per nesting pair and 1.8 young per resident pair. The average number of young fledged was 1.8 per nesting pair and 1.5 per resident pair. Henny (1972) estimated that Red-tailed Hawks need to fledge about 1.4 young per breeding female to maintain a stable population. If Ferruginous Hawks require a similar rate the population we studied had an adequate recruitment rate.

We attributed the loss of four clutches to red foxes (*Vulpes vulpes*), one to a badger (*Taxidea taxus*), and two to unknown mammals. One ground nest was abandoned because of human disturbance, one was destroyed by an avian predator, and two tree nests were destroyed by wind. Young were lost from five tree nests when they fell to the ground. In two instances young which fell to the ground were cared for by the pair and fledged successfully.

Hatching success of nests on our area was lower than the 65% found by Smith and Murphy (1973), the 70% noted by Olendorff (1973) and much lower than the 92% calculated by Platt (1971). Predator destruction of eggs in ground nests was the cause of the lower hatching success. Predators caused 8 of 11 nest failures; all of these nests were destroyed during the egg-laying season.

During the two years, eggs hatched in 92% of the nests located in trees compared to 33% for ground nests. The average of 2.2 young fledged in tree nests was not significantly different than the average of 1.3 young fledged in ground nests (Wilcoxin rank sum test). However, successful tree nests fledged significantly fewer young (1.2) for each nest than did successful ground nests (Wilcoxin rank sum test, $P < 0.07$). The reason for the higher production from ground nests is that 80% of the young hatched in ground nests fledged compared to only 50% in tree nests. Also, clutch size was 0.6 egg greater in ground nests, and egg hatchability was 80% compared to 74% in tree nests.

Mankind has detrimentally affected the breeding environment of Ferruginous Hawks by destroying native prairie, increasing nest disturbance, and indirectly increasing predator populations. The negative aspects of these changes have been partly offset by the addition of trees and by the construction of haystacks. The Ferruginous Hawk has adapted to man-caused changes by nesting in the more secure tree sites, but successful tree nests produce young at a lower rate than successful

TABLE 4. Prey items of the Ferruginous Hawk.[a]

Species	Number	Percent occurrence	Avg. wt. adult prey (gm)	Total biomass (gm)	Percent total biomass
Mammals					
Spermophilus richardsoni	75	96	350	26,250	68
Thomomys talpoides	4	5	145	580	2
Reithrodontomys megalotis	2	1	11	22	Tr[b]
Microtus pennsylvanicus	8	8	23	184	Tr
Microtus ochrogaster	1	1	23	23	Tr
Ondatra zibethica	1	1	922	922	2
Lepus townsendi	2	4	3360	6720	17
Sylvilagus floridanus	1	1	1135	1135	3
Birds					
Eggshell	1	1	25	25	Tr
Unidentified *Anas*	1	1	700	700	2
Phasianus colchicus	1	1	1304	1304	3
Sturnella neglecta	4	5	145	580	2
Unidentified passerine	1	1	25	25	Tr
Insects					
Scarabaeidae	28	5	0.3	8	Tr

[a] Data from 71 pellets and 7 items observed at nests. Weights of mammals taken mainly from Gunderson and Beer (1953).
[b] Tr = trace.

ground nests. Olendorff (1973) noted that more young were fledged from nests in natural sites, but he considered planted trees to be beneficial for the species.

We have no evidence that Ferruginous Hawks laid two clutches in a single year. Several pairs built two nests but eggs were not laid in more than one nest.

PREY ITEMS

The Richardson's ground squirrel (*Spermophilus richardsoni*) comprised the most important food item in terms of total biomass and frequency of occurrence (table 4). Richardson's ground squirrels are abundant in this region and occur in large colonies in moderately and heavily grazed pastures. White-tailed jackrabbits (*Lepus townsendi*) ranked second in total food biomass but were unimportant in frequency of occurrence, and rabbit parts occurred in only two pellets. In total, mammals comprised 93% of the food biomass; birds, 7%; and insects, a trace.

In the southwest United States, black-tailed jackrabbits (*L. californicus*) are an important food item of *Buteo regalis* (Smith and Murphy 1973, Weston 1968). Thirteen-lined ground squirrels (*S. tridecemlineatus*) comprised 41% of the prey in Colorado (Olendorff 1973). The white-tailed jackrabbit is an unimportant prey on our study area possibly because of its large size (about 3400 gm). Cameron (1914) reported that Ferruginous Hawks were probably unable to carry a 2724-g animal.

The average size of 54 complete pellets was 23 ± 4.9 mm by 45 ± 13.3 mm. Length varied from 24 to 84 mm and width varied from 12 to 36 mm. On a dry weight basis pellets contained an average of 72% hair, 22% bone, 3% plant material, 1% feathers, and 2% insect or small grit. The mineral and plant particles were probably ingested accidentally.

COLOR PHASES

Only 1 of the 62 Ferruginous Hawks on the area had a melanistic plumage. Also, none of the birds seen off the study area or any young were melanistic, so the occurrence of dark-phase birds in this region was less than 1%. Olendorff (1973) reported that 3% of the hawks had black plumage in northeast Colorado and another portion had dark plumage. C. S. Houston (pers. comm.) estimated that 30% of the Ferruginous Hawks in southwest Saskatchewan were melanistic.

SUMMARY

The breeding ecology of the Ferruginous Hawk was studied in north-central South Dakota in the spring and summer of 1973 and 1974. Notes on other raptors of the 269-km^2 study area were also kept. The Ferruginous Hawk population averaged one pair per 17.4 km^2 and the total raptor population was estimated at one pair per 11.2 km^2.

Ferruginous Hawks nested on the ground, on haystacks, and in trees. Ground nests were generally found in remote areas within large

prairie tracts in high condition. Tree nests were found in both cultivated and prairie sites and not necessarily in remote areas. However, prairie is an important component within all territories as it provides habitat for prey species.

The average clutch of 4.3 eggs was substantially larger than clutch sizes reported in the literature. The large clutches may have resulted in part from the abundance of Richardson's ground squirrels—the principal prey species on the study area. Nest hatching success for the 2 years was 63%, and an average of 1.5 young were fledged for each resident pair. At this level of recruitment, Ferruginous Hawks on our study area apparently fledged adequate young to maintain population stability. A large proportion of the ground nests were lost to predation.

ACKNOWLEDGMENTS

We thank Paul F. Springer, Robert E. Stewart and Harold A. Kantrud for reviewing the manuscript and Douglas H. Johnson for statistical treatment of the data.

LITERATURE CITED

BENT, A. C. 1937. Life histories of North American birds of prey. Part I. U. S. Natl. Mus. Bull. 167.

CAMERON, E. S. 1914. The Ferruginous Rough-leg, *Archibuteo ferrugineus*, in Montana. Auk 31: 159–167.

FLINT, R. F. 1955. Pleistocene geology of eastern South Dakota. Geological Surv. Prof. Paper 262. U.S. Govt. Printing Office, Washington, D. C.

GUNDERSON, H. L., AND J. R. BEER. 1953. The mammals of Minnesota. Minn. Mus. Nat. Hist. Occ. Papers. No. 6.

HENNY, C. J. 1972. An analysis of the population dynamics of selected avian species. U.S. Fish and Wildl. Serv. Wildl. Res. Rept. 1.

HICKEY, J. J. 1969. Peregrine Falcon populations. Univ. Wisconsin Press, Madison.

KORSCHGEN, L. R. 1969. Procedures for food-habits analyses, p. 233–250. *In* R. H. Giles, Jr. [ed.], Wildlife management techniques. Wildlife Society, Washington, D.C.

LACK, D. 1966. Population studies of birds. Clarendon Press, Oxford.

OLENDORFF, R. R. 1973. The ecology of the nesting birds of prey of north-eastern Colorado. U.S. I.B.P. Grassland Biome Tech. Rep. No. 211.

PLATT, J. B. 1971. A survey of nesting hawks, eagles, falcons and owls in Curlew Valley, Utah. Great Basin Nat. 31:51–65.

RATCLIFFE, D. A. 1967. Decrease in eggshell weight in certain birds of prey. Nature 215:208–210.

ROLFE, E. S. 1896. Nesting of the Ferruginous Rough-leg. Osprey 1:8–10.

SMITH, D. G., AND J. R. MURPHY. 1973. Breeding ecology of raptors in the eastern Great Basin of Utah. Brigham Young Univ. Sci. Bull. Bio. Ser. 18:1–76.

STEWART, R. E. 1976. Breeding birds of North Dakota. North Dakota State Univ. Press, Fargo.

U. S. DEPARTMENT OF COMMERCE. 1974. Climatological data—South Dakota. Annual summary. Vol. 79, Weather Bureau, Asheville, N.C.

U. S. DEPARTMENT OF INTERIOR. 1970. The national atlas of the United States of America. Geological Survey.

WESTON, J. B. 1968. Nesting ecology of the Ferruginous Hawk, *Buteo regalis*. Brigham Young Univ. Sci. Bull. Bio. Ser. 10:25–36.

Northern Prairie Wildlife Research Center, Fish and Wildlife Service, U.S. Department of the Interior, Jamestown, North Dakota 58401. Accepted for publication 17 November 1975.