

APPENDIX E
SPECIES ACCOUNT: FERRUGINOUS HAWK

FERRUGINOUS HAWK (*Buteo regalis*)

Species Status

The Ferruginous Hawk is listed as a threatened species in Utah and is considered a species of special concern in Colorado, Arizona and Oklahoma, but the USFWS rejected a petition to list the Ferruginous Hawk under the ESA (USFWS 1992). This species is listed as a USFWS Species of Concern (USFWS 1996), a USFS Region 2 sensitive species, a BLM sensitive species, and a CITES Appendix II species. The Partners in Flight Watchlist identifies the Ferruginous Hawk as a "High Priority" species for Wyoming, North Dakota, South Dakota and Nebraska. The Commission for Environmental Cooperation (2000) established under the North American Free Trade Agreement, has identified the Ferruginous Hawk as a priority grassland species for conservation action. In Canada, the Ferruginous Hawk was downlisted from threatened to vulnerable in 1995. It is considered a species of conservation concern in Mexico (Commission for Environmental Cooperation 2000). The Colorado Natural Heritage Program (CNHP) has ranked the Ferruginous Hawk G4/S3B-S5N (apparently secure globally; breeding birds vulnerable in Colorado) (CNHP 2003).

The breeding distribution of Ferruginous Hawks in Canada has declined to about 50% of its former range (Houston and Bechard 1984; Schmutz et al. 1992; Preston 1998). During the past ten years, however, population declines have only been documented in eastern Nevada and northern Utah (Olendorff 1993; Preston 1998). Increases have been reported for Canada (Schmutz and Hungle 1989), California (Warkentin and James 1988), Montana and North Dakota (Dobkin 1994). Olendorff (1993) reported Ferruginous Hawk numbers stable in Colorado during the 1979-1992 time period. Breeding Bird Survey data for the U.S. and Canada indicate an average annual increase of 0.5% for 1966-1989 (Droege and Sauer 1990). Breeding Bird Survey data from 1966-1996 for Partners in Flight Physiographic Area 36 (the Central Shortgrass Prairie) do not show a statistically significant change (Colorado Partners in Flight 2000). Data from all BBS regions for the Ferruginous Hawk, however, have a suitability index of red (data with an important deficiency) or yellow (data with a deficiency) (Sauer et al. 2001). In addition, BBS data cover only 37 years, but changes to Ferruginous Hawk habitat have been taking place for a considerably longer period of time (Preston 1998).

Christmas Bird Count data from 1952-1984 indicate a significant increase in wintering Ferruginous Hawk numbers, with the most pronounced increase occurring between 1973 and 1984 (Warkentin and James 1988; USFWS 1992).

Description and Taxonomy

The Ferruginous Hawk is one of the largest North American hawks, measuring approximately 23 in, with a wingspan of 53 in. This bird is distinguished by its pale head, rust coloring on back, shoulders and legs, and white underparts. When seen from below, the rust-colored legs form a dark V-shape and flight feathers lack barring. Immature birds lack the rust-colored leggings. The dark morph is rare and can be distinguished by its lack of dark tail bands (National Geographic Society 1987).

The Ferruginous Hawk was originally described in 1844 by G.R. Gray as *Archibuteo regalis* (AOU 1998). There are no subspecies recognized, but there are two separate sub-populations east and west of the Rocky Mountains (Bechard and Schmutz 1995).

Historical and Current Distribution

The breeding range of the Ferruginous Hawk is discontinuous throughout most of the western U.S. and in southern Alberta and Saskatchewan, and extreme southwestern Manitoba (National Geographic Society 1987; Bechard and Schmutz 1995). Breeding range in the U.S. includes the Pacific coastal states of Washington and Oregon, and extends eastward to the western portions

of Texas, Oklahoma, Kansas, Nebraska and the Dakotas, and south to Arizona and New Mexico (National Geographic Society 1987). Year-round range includes Colorado, portions of Utah, southeastern Nevada, northern Arizona and New Mexico, western Texas, Oklahoma, Kansas, Nebraska and southwestern South Dakota. Winter range extends from southcentral Oregon through California, western Nevada, southern Arizona and New Mexico, southwestern Texas and northern Mexico (National Geographic Society 1987). Ferruginous Hawks in Washington, Montana, North Dakota and Canada are migratory, while those in the southern part of the breeding range appear to migrate short distances or are sedentary (Bechard and Schmutz 1995).

The Ferruginous Hawk still occurs broadly in most historically reported areas, but its range has retracted in Alberta, Saskatchewan and Manitoba (Bechard 1981; Houston and Bechard 1984; Schmutz 1984), and it has been nearly extirpated from the northeast quarter of North Dakota (Stewart 1975; Bechard and Schmutz 1995). The Ferruginous Hawk historically wintered in the Los Angeles area (Wyman 1914; Bechard and Schmutz 1995).

In Colorado, about three-quarters of Breeding Bird Atlas latilong blocks in which the Ferruginous Hawk was detected were scattered across the eastern plains, with the remaining reports originating in the San Luis Valley, South Park and Colorado Plateau (Preston 1998). Andrews and Righter (1992) considered the Ferruginous Hawk a rare to uncommon summer resident and a fairly common to common winter resident on Colorado's eastern plains. Occurrences on the western slope, mountain parks and San Luis Valley were considered uncommon to rare (Andrews and Righter 1992).

Life History and Habitat

Breeding habitat

The Ferruginous Hawk is a bird of open grasslands and shrub steppe communities (Bechard and Schmutz 1995). These birds nest in flat, rolling or rugged terrain in open areas, including shortgrass prairie, canyons with cliffs or rock outcrops and areas with isolated trees or small groves in grasslands, shrublands or riparian areas (Smith and Murphy 1973; Woffinden 1975; Lokemoen and Duebbert 1976; Cottrell 1981; Roth and Marzluff 1989; Olendorff 1993; Bechard and Schmutz 1995; Dechant et al. 2001). The Ferruginous Hawk avoids areas of intensive agriculture or high human disturbance (Gilmer and Stewart 1983; Schmutz 1984, 1987; Bechard et al. 1990; Schmutz 1991), high elevation, interior forests and narrow canyons (Ensign 1983; Bechard et al. 1990; Restani 1991). Gilmer and Stewart (1983) found lands within 1.0 km of nests were mostly (76.5%) pasture and haylands. Kantrud and Kologiski (1982) found highest densities of the Ferruginous Hawk in heavily grazed areas in the northern Great Plains. In South Dakota, nests were preferentially placed in lightly grazed pasture or idle areas (Lokemoen and Duebbert 1976; Blair 1978; Blair and Schitoskey 1982).

The structure of Ferruginous Hawk nests suggests that ground nesting was predominant in the past (Bechard and Schmutz 1995). Selection for nest sites now appears to depend on a combination of available substrates and surrounding land use. The Ferruginous Hawk appears to prefer elevated nest sites, but will nest on the ground if elevated sites are not available (Bechard and Schmutz 1995). Elevated nest sites include boulders, creek banks, knolls or low cliffs, buttes, large shrubs, trees in isolated areas or around old homesteads (Olendorff 1973; Schmutz 1984; Gaines 1985), haystacks adjacent to hayfields (Rolfe 1896; Davy 1930; Lokemoen and Duebbert 1976; Gilmer and Stewart 1983), and utility structures (Gilmer and Wiehe 1977; Gilmer and Stewart 1983; Steenhof et al. 1993; Bechard and Schmutz 1995). Nests on the ground are typically located far from human activities and on elevated landforms within grassland areas (Blair 1978; Gilmer and Stewart 1983; Preston 1998) such as slopes, knolls and crests of ridges (Palmer 1988). When trees are the nesting substrate, lone or peripheral trees are preferred to densely wooded areas (Weston 1968; Lokemoen and Duebbert 1976; Gilmer and Stewart 1983; Woffinden and Murphy 1983; Palmer 1988; Bechard et al. 1990; Leslie 1992; Hansen 1994; Dechant et al. 2001). Ferruginous Hawks nesting in trees appear to be less sensitive to

disturbance than those nesting on the ground, but they still avoid areas of intensive agriculture or high levels of human disturbance (Gilmer and Stewart 1983; Schmutz 1984, 1987, 1991; Bechard et al. 1990).

Documented nest height ranges from ground level to greater than 20 m above ground (Bechard and Schmutz 1995). Olendorff (1993) found that 49% of 2,119 nests described rangewide were in trees and shrubs, 21% were on cliffs, 12% were on utility structures and 10% were on ground outcrops. In Colorado, approximately 41% of nests were in human-made settings (Olendorff and Stoddard 1974; Gaines 1985). Johnsgard (1979) found approximately 50% of 61 nests in North Dakota were on the ground in prairie vegetation. Gilmer and Stewart (1983), however, found 64% of nests in trees and only 21% of nests on the ground in North Dakota.

Use of Prairie Dog Towns

Prey availability influences habitat selection. The Ferruginous Hawk appears to avoid dense vegetation limiting visibility of prey (Howard and Wolfe 1976; Wakeley 1978). Grazing by large herbivores and prairie dogs benefits the Ferruginous Hawk by reducing plant cover and making prey more visible (Wakeley 1978; Gilmer and Stewart 1983). Plumpton and Andersen (1997) found that the black-tailed prairie dog was the most important prey species for the Ferruginous Hawk in Colorado, and that Ferruginous Hawk winter habitat was characterized by extant black-tailed prairie dog colonies. Berry et al. (1998) found counts of the Ferruginous Hawk in Boulder, Colorado were positively correlated with proximity to the nearest black-tailed prairie dog colony. Plumpton and Andersen (1998) found Ferruginous Hawks at the Rocky Mountain National Wildlife Refuge in Colorado were most numerous where black-tailed prairie dogs were most plentiful.

Roth and Marzluff (1989) found approximately 86% of nests in western Kansas (n=99) were not in direct view of black-tailed prairie dog towns, but most were within 8 km of towns. The infrequent occurrence of nests further away from prairie dog towns was attributed to a behavioral response to prey abundance (i.e., placement of nests close to sources of prey). Numbers of the Ferruginous Hawk decrease when local prairie dog populations die off (Andrews and Righter 1992), but the relationship between prairie dogs and Ferruginous Hawk survivorship is unknown. When black-tailed prairie dog towns at the Rocky Mountain Arsenal National Wildlife Refuge were reduced by up to 99% during a plague epizootic, a significant relationship was found in the numeric response of the Ferruginous Hawk to changes in the area of black-tailed prairie dog towns and in the minimum estimated population of black-tailed prairie dogs, but not to estimated black-tailed prairie dog density (Seery and Matiatos 2000).

Use of Cultivated Fields

The Ferruginous Hawk will nest in cropland and hayland if coverage is less than 50% (Blair 1978; Wakeley 1978; Gilmer and Stewart 1983; Konrad and Gilmer 1986; Schmutz 1989, 1991; Bechard et al. 1990; Faanes and Lingle 1995; Leary et al. 1998), but avoids areas of intensive agriculture for nesting. In most states, including Colorado, Ferruginous Hawks prefer grasslands and pastures to cultivated areas (Olendorff 1973; Janes 1985; Konrad and Gilmer 1986; Roth and Marzluff 1989; Atkinson 1992; Black 1992; Leslie 1992; Preston 1998; Bechard et al. 1990; Dechant et al. 2001). Olendorff and Stoddard (1974) found only 1 out of 71 nests in northeastern Colorado were in cultivated lands. In Kansas, Roth and Marzluff (1989) found 59 Ferruginous Hawk nests in areas where rangeland was the predominant land use, but only 5 nests in areas where cropland constituted over 50% of the area. In Oregon, Cottrell (1981) found only one Ferruginous Hawk nest out of 46 in farmland. Gilmer and Stewart (1983) found only 8% of 629 occupied nests in North Dakota in areas where cultivated lands were predominant, and that pasture was the only land use within 100 m of ground nests. Cultivated areas in Alberta, however, had higher densities of nesting Ferruginous Hawks than were found in grassland areas (Schmutz 1989), and Podany (1996) found no significant difference in the number of fledglings produced in unfragmented rangeland compared to a mixture of rangeland and cropland.

Cultivated lands are used for foraging by the Ferruginous Hawk. Leary et al. (1998) found agricultural fields were important foraging areas when prey densities were low in native habitat. The Ferruginous Hawk foraged extensively in cultivated fields in Washington and Idaho during the breeding season (Wakeley 1978; Leary et al. 1998). Zelenak and Rotella (1997) attributed higher nest success in nests closer to cultivated fields and roads to the higher prey densities associated with the edge habitat. Intensive agricultural activities such as yearly plowing and biennial fallowing, however, preclude many prey species (Wakeley 1978; Houston and Bechard 1984; Dechant et al. 2001). Schmutz (1989) found that when an area of cultivation is below 30%, prey abundance increases, but abundance decreases once the area of cultivation exceeds 30%.

Wintering and Migration Habitat

The Ferruginous Hawk east of the Rocky Mountains winters primarily in grasslands, particularly those where prairie dogs are abundant (Bechard and Schmutz 1995). In Texas, Schmutz (1987) found patches of grassland supporting prairie dogs intermixed with extensive cultivation attracted many wintering Ferruginous Hawks. Schmutz concluded that agricultural practices and human activity did not have a negative effect on the Ferruginous Hawk during winter. Migrating birds east of the Rocky Mountains follow grasslands where ground squirrels and prairie dogs are available, while western birds use desert habitats where lagomorphs are abundant (Schmutz and Fyfe 1987).

Reproduction

The Ferruginous Hawk arrives on breeding grounds in late February or early March in southern portions of the breeding range, and in late March to early April in northern areas (Olendorff 1973; Smith and Murphy 1973; Lokemoen and Duebbert 1976; Schmutz et al. 1980; Bechard and Schmutz 1995). Nest building usually occurs in March in Utah and Colorado, and in April in North Dakota, Alberta and Saskatchewan (Schmutz et al. 1980; Bechard and Schmutz 1995). The male and female share in nest site selection, which typically involves visiting several nests from previous years (Bechard and Schmutz 1995). A pair may repair two or three nests before selecting one for egg laying (Olendorff 1973; Powers 1981). If interrupted during nest building, the Ferruginous Hawk may choose another site (Smith and Murphy 1973).

Brood dates range from mid-March to mid-May (early to mid-April in Colorado) (Olendorff 1993). Average clutch size is two to four, but ranges from one to eight, depending on abundance of prey (Smith and Murphy 1978; Smith et al. 1981; Palmer 1988; Bechard and Schmutz 1995). One clutch is produced per season (Bechard and Schmutz 1995). Re-nesting is rare (Woffinden 1975; Palmer 1988). Though the male does some incubating, the majority of incubating is done by the female while the male hunts and guards the nest (Powers 1981; Bechard and Schmutz 1995). The incubation period is 32-33 days (Palmer 1988).

The female broods the young for three weeks post-hatching and then begins to hunt again (Bechard and Schmutz 1995). Young leave the nest at 38-50 days (Powers 1981; Konrad and Gilmer 1986), but remain less than 200 m from the nest for some time (Powers 1981). In Colorado, fledglings have been recorded from late June to late July (Preston 1998). Fledglings can kill prey at 52 days (Angell 1969) and although they are proficient flyers by two weeks post-fledging (Bechard and Schmutz 1995), they remain dependent on their parents for several weeks (Blair and Schitoskey 1982).

Fidelity to nesting locations from year to year is high and several nests may be built in an area and used in alternate years (Davy 1930; Weston 1968; Olendorff 1973; Blair 1978; Smith and Murphy 1978; Palmer 1988; Roth and Marzluff 1989; Schmutz 1991; Atkinson 1992; Houston 1995). Reoccupancy of nest sites may be related to nest success in prior years. De Smet (1992) found that 52% of successful nests were reused (n=71), but only 14% of unsuccessful nests were

reused (n=63). Bechard and Schmutz (1995) reported one nest site that fledged young for 32 consecutive years.

Lifetime reproductive output is unknown, but one male in Alberta contributed to the fledging of at least 20 young over a seven-year timeframe (Bechard and Schmutz 1995). Mean annual reproductive success ranges from 1.3-3.2 fledglings per breeding pair per year rangewide (Lokemoen and Duebber 1976; Fitzner et al. 1977; Smith and Murphy 1978; Thurow et al. 1980; Gilmer and Stewart 1983; Roth and Marzluff 1989; Houston 1991). Mean rates reported for states in the eastern portion of the breeding range are 2.1-2.2 (Lokemoen and Duebber 1976; Gilmer and Stewart 1983; Roth and Marzluff 1989). The Ferruginous Hawk begins breeding at two years of age (Bechard and Schmutz 1995), but the number of pairs breeding in a particular area during any given year is dependent upon prey availability (Thurow et al. 1980; Woffinden and Murphy 1989; Bechard and Schmutz 1995). Olendorff (1978) estimated nest success on the PNG at 69.8% (n=35 nests). Nest failure in northwest Colorado and northeast Utah was estimated at 25% during a year of high prey abundance and at 74% during a year of low prey abundance (USFWS 1992).

Diet

The Ferruginous Hawk is restricted in its selection of prey. It feeds primarily on prairie dogs and ground squirrels east of the Continental Divide, on jackrabbits or cottontail rabbits west of the Divide (Olendorff 1993) and less frequently on locusts, crickets, birds, amphibians and reptiles (Weston 1968; Gilmer and Stewart 1983; Ehrlich et al. 1988; Finch 1991; Gillihan and Hutchings 2000; Dechant et al. 2001). In Colorado, Preston and Beane (1996) reported that the Ferruginous Hawk feeds most often on prairie dogs, especially in winter. Olendorff (1993) reported ground squirrels as the most important prey item in Colorado, followed by pocket gophers and jackrabbits. Data from 20 studies indicate that ground squirrels and prairie dogs are taken most frequently, but that rabbits and hares represent most of the biomass (Olendorff 1993).

Density and productivity of the Ferruginous Hawk is closely associated with cycles of prey abundance (Woffinden 1975; Smith et al. 1981; White and Thurow 1985; Schmutz 1989; Schmutz and Hungle 1989; Bechard and Schmutz 1995). Abundant prey populations and stability of prey habitat are necessary to maintain high breeding densities, high rates of reproductive success and recruitment in Ferruginous Hawk populations (USFWS 1992). Local influxes of the Ferruginous Hawk have been documented in response to prey availability (Gilmer and Stewart 1983).

Survivorship and Mortality

Maximum longevity is 20 years (Lloyd 1937; Houston 1984). Schmutz and Fyfe (1987) estimated a first-year mortality rate of 65% based on banding data from the 1970s and 1980s. Bechard and Schmutz (1995) considered this an over-estimate because most mortality was human-related. Woffinden and Murphy (1989) estimated adult mortality at 25% based on reoccupancy of nest sites. This may also be an over-estimate given the species' potential for dispersal (Bechard and Schmutz 1995).

Causes of mortality include exposure, predation, shooting, vehicle collisions, other injuries and collisions with towers or high-tension wires (Gossett 1993; Bechard and Schmutz 1995). Eggs and young may be blown or pushed from the nest (Olendorff 1993). Gilmer and Stewart (1983) found that summer storms were a major cause of nest loss, with nests in trees being particularly vulnerable. The primary predator of nestlings is the great horned owl, but eggs and nestlings may also be preyed upon by common ravens and crows (*Corvus* spp) (Bechard and Schmutz 1995). Coyotes (*Canis latrans*), badgers (*Taxidea taxus*), and foxes (*Vulpes* spp) may represent a serious predation threat to fledglings and pairs that nest on the ground (Bechard and Schmutz 1995). According to the USFWS (1992), however, predation is not known to be a widespread problem throughout the range of the Ferruginous Hawk.

Abundance

Olendorff (1993) estimated the continent-wide population at 5,842-11,330 birds. Schmutz et al. (1992) estimated 14,000 birds on the Great Plains. Because between-year movement of these birds is common, estimation of abundance is difficult.

In Colorado, Ferruginous Hawk numbers have been stable from 1979-1992 (Olendorff 1993). Although the Ferruginous Hawk is found in Colorado year round (Preston 1998; Gillihan and Hutchings 2000), it is most common in winter in eastern Colorado. Johnsgard (1990) estimated that about 1,200 birds winter in Colorado, which comprises about 20% of the total winter population in the United States. Preston (1998) documented about 150 nest sites in Colorado, primarily on the eastern plains. Past estimates of abundance for breeding Ferruginous Hawks in Colorado include 150-175 pairs in 1979, and 300-400 pairs in 1991 (USFWS 1992). According to Leslie (1990), Ferruginous Hawk numbers on the PNG decreased by 38.5%, down from 26 pairs in 1972 to 16 pairs in 1990.

Area Requirements

Like other raptors, the Ferruginous Hawk is widely dispersed and found at low densities, especially during the nesting season (Fuller et al. 1995; Preston 1998). Olendorff (1993) found an average nearest-neighbor distance of 13.4 km (range 0.8-7.2 km) over 11 study areas in the U.S. On the PNG, the Ferruginous Hawk been found at an estimated breeding density of one pair per 108 km² (Olendorff 1972). Estimates of home range are 5.9 km² in Utah (Smith and Murphy 1973; Wakeley 1978), 7.6 km² for breeding males in Idaho (McAnnis 1990), and 3.14-8.09 km² in the Columbia River Basin and Great Basin (Janes 1985). Leary et al. (1998) reported an average home range size of 90.3 km² in Washington, with the variability in home range size significantly related to distance between the nest and the nearest irrigated agricultural field. Wakeley (1978) estimated that one pair might require up to 21.7 km² for hunting.

Migration

Very little is known about migration of the Ferruginous Hawk in the southern portion of the breeding range, but they are believed to be sedentary or to migrate only short distances (Bechard and Schmutz 1995). Populations from the northern breeding range (Washington, Montana, North Dakota and Canada) are completely migratory. Southward migration begins in August, late September or early October (Schmutz and Fyfe 1987). The Ferruginous Hawk returns to South Dakota in late March to early April, and to Utah and Colorado in late February or early March (Lokemoen and Duebbert 1976). Most birds breeding in the Great Plains winter in Texas and northern Mexico (Bechard and Schmutz 1995). There is some crossover between the population east of the Continental Divide and west of the Continental Divide. Gossett (1993) documented 4.1% of eastern birds were recovered west of the Divide and 27.5% of western birds recovered east of the divide.

Reasons for Decline

Primary concerns are loss of nesting habitat (especially conversion of grasslands to cropland and urban development), reduction in prey availability through control programs targeting primary prey species (i.e., prairie dogs, ground squirrels) and human disturbance at nest sites (Preston 1998; Colorado Partners in Flight 2000; Commission for Environmental Cooperation 2000; Gillihan and Hutchings 2000).

Conversion of Grasslands

Conversion of grasslands to row crops, at least locally, has been implicated in declines of the Ferruginous Hawk (Lokemoen and Duebber 1976; Gilmer and Stewart 1983; Finch 1991; Ostlie et al. 1997; Preston 1998; Commission for Environmental Cooperation 2000; Gillihan and Hutchings 2000). Intensive agricultural development renders native habitat such as grasslands essentially useless for Ferruginous Hawk nesting (USFWS 1992). The Ferruginous Hawk will avoid frequently plowed fields due to lower densities of prey in monotypic agricultural fields, absence of nest trees and higher rates of human disturbance during springtime (i.e., the nesting season) (USFWS 1992). In addition, although cropland is used as foraging habitat by the Ferruginous Hawk, reduced access to prey may result if crops grow too tall or dense to allow it to see prey. Ability of remaining grasslands to support viable populations may be reduced in areas invaded by exotic annuals such as cheatgrass (*Bromus tectorum*) (TNC 1999).

Decline of Burrowing Mammals

Reductions in ground squirrel and prairie dog populations, either through habitat conversion or through poisoning and control programs, result in loss of prey base for the Ferruginous Hawk. Although pesticides are not known to pose a serious direct threat to the Ferruginous Hawk (Bechard and Schmutz 1995), use of strychnine to poison ground squirrels is a possible threat (Schmutz et al. 1989). Almost 80% of eastern Colorado's black-tailed prairie dog colonies occur on private land (EDAW 2000). Due to continued control efforts, it is likely that black-tailed prairie dog colonies on most private land will tend to be small and thus not provide the higher quality foraging habitat of large colonies and complexes.

Sensitivity to Disturbance

The Ferruginous Hawk is easily disturbed during the breeding season (Olendorff 1973; Gilmer and Stewart 1983; Schmutz 1984; White and Thurow 1985; Bechard et al. 1990; Preston 1998; Gillihan and Hutchings 2000). Nest abandonment may occur, particularly during incubation (Davy 1930; Weston 1968; Fitzner et al. 1977; Gilmer and Stewart 1983; White and Thurow 1985). White and Thurow (1985) found that the Ferruginous Hawk did not increase its tolerance to repeated disturbance over time, but rather became more sensitive, flushing at greater distances until just before eggs hatched. Their data further suggested that when a pair deserted a nest after disturbance, it moved completely out of the area the following year, rather than nesting in an alternate nest in the same territory. Only 52% of the territories that contained disturbed nests were occupied the following year, compared to 93% of territories containing control nests (White and Thurow 1985). Intensity of disturbance response depended on whether the disturbance was familiar, regardless of whether humans were associated with the disturbance. Adults subjected to disturbance appeared to be less attentive to the young and fledged significantly fewer young. The presence of humans near nests might also raise the mortality rate of young by causing them to fledge prematurely. Sensitivity to disturbance also increased during low prey abundance (White and Thurow 1985).

In eastern Colorado and South Dakota, nests in remote locations exhibited higher productivity than did nests in more accessible locations (Olendorff 1973; Blair 1978). The Ferruginous Hawk avoids nesting in cropland and in areas near farmyards and occupied buildings (Schmutz 1984; Gaines 1985). Olendorff (1993) reported nest abandonment related to mining disturbance. Nesting does occur, however, near active railroads and gravel roads (Rolfe 1896; Gilmer and Stewart 1983; MacLaren et al. 1988). Gilmer and Stewart (1983) found that pairs nesting within 500 m of interstates or well-traveled roads acclimated to activity on the roads and exhibited similar rates of nest success to other pairs.

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