Occupancy, breeding success, and productivity of Ferruginous Hawks in central, western and northwestern New Mexico, 2004

Prepared for:

Bureau of Land Management, Farmington and Socorro Field Offices

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INTRODUCTION

The Ferruginous Hawk (*Buteo regalis*) is an open-country species that inhabits grassland, shrub-steppe and semi-desert regions of western North America (Bechard and Schmutz 1995). They breed in 17 states and three provinces in Canada, and use nesting substrates ranging from cliffs, trees, utility structures, and farm buildings to haystacks and relatively level ground. The wide array of nest structures makes them one of the most versatile nesters among the *buteos* (Call 1978). Bechard and Schmutz (1995) described their general behavior as "wary of humans" and "secretive". Even when nesting at similar densities with other grassland *buteos*, they are the most inconspicuous (Schmutz 1984). Bechard *et al*. (1990) noted that Ferruginous Hawks nested more than twice as far from human habitation than other grassland *buteos*.

The status of the Ferruginous Hawk is uncertain throughout its range. Reports of declining numbers of this *buteo* (Woffinden 1975, Powers and Craig 1976, Murphy 1978, Bechard 1981, Evans 1982, Houston and Bechard 1984, Schmutz 1984, Moore 1987, Smith 1987, Woffinden and Murphy 1989) led to the filing of a petition in May 1991 with the United States Fish and Wildlife Service (USFWS) requesting that the species be listed under the Endangered Species Act (Ure *et al*. 1991). The petition was rejected; but Ferruginous Hawks, whose numbers were estimated to be between 5,220-6,000 nesting pairs (Olendorff 1993), are considered a "candidate species" by the USFWS (U.S. Fish and Wildl. Serv. 1992), a "sensitive species" by the Bureau of Land Management (BLM) (Bechard and Schmutz 1995), a "Tier I Priority Species" by New Mexico Partners in Flight, and a species of concern (G4) for the Nature Conservancy.

A Ferruginous Hawk conservation meeting was held in Boise, ID on 1-2 December 2004, and was attended by government land managers and wildlife biologists from five western states and Washington, D.C. Other notable non-government groups such as Hawks Aloft Inc. (HAI), HawkWatch International, Partners in Flight, Boise State University, and the Nature Conservancy also attended this meeting. The principal purpose of the meeting was to exchange regional information about research, inventory, and monitoring efforts being conducted by various entities. The need for consistent region-wide monitoring and conservation planning was discussed. Without range-wide monitoring, accurately identifying change in population demographics would be difficult, and establishing proactive management techniques would be impossible (M. Fuller, pers. comm.).

In order to adequately assess the status of the Ferruginous Hawk population, Olendorff (1993) recommended implementing a standardized monitoring program that could assess long-term population trends and nest substrate use over the species' entire range.

Several researchers have emphasized the importance of surveying all known historic Ferruginous Hawk nest sites since these birds show an affinity to move to areas of more abundant prey availability when resources become limited (Wakeley 1978, Newton 1979, Woffinden and Murphy 1989, Watson 2003). Although it is imperative that wildlife biologists know how many Ferruginous Hawks are nesting on the lands they manage, the nomadic behavior of this species suggests that, in order to begin to understand population dynamics and identify trends, a larger perspective is needed. For this reason, HAI surveys Ferruginous Hawk nesting activity within the study area regardless of land ownership. The large size of Ferruginous Hawk home ranges, combined with the common checkerboard patterns of state, federal, Native American, and private land ownership, necessitate the discussion of population level trends for this species. We provide these data regarding population status to enable land managers to make timely decisions and effectively manage this species in their resource area.

Study Areas

Farmington Study Area

This study area is located in the northwestern portion of New Mexico, south of Farmington and north of Chaco Canyon. The Navajo Nation borders the survey area to the west, and U.S. Highway 550 constitutes the eastern border. The dominant vegetation is characterized as Great Basin Desert Scrub and Desert Grassland (Dick-Peddie 1993).

Big sagebrush (*Artemesia tridentata*) is a common shrub throughout the area. Nests mainly occur on sandstone hoodoos, cliffs, or pinnacles. The land is primarily owned by BLM with a complicated patchwork of state, Navajo Nation, and private lands in some areas. Two important areas (the Bisti and De-Na-Zin) are designated BLM Wilderness Areas, and one (Ah-shi-sle-pah) is designated a Wilderness Study Area.

Socorro Study Area

The Plains of San Agustin is a topographically closed basin in Socorro and Catron Counties. The study area is north of the Luera Mountains, west of the town Magdalena, south of the Gallinas, Datil, and Mangas Mountains, and east of the Tularosa Mountains. Dominant vegetation types include Plains-Mesa Grassland, Desert Grassland, Juniper Savanna and Coniferous and Mixed Woodland (Dick-Peddie 1993). Dominant grasses include blue grama *(Bouteloua gracilis)* and black grama (*Bouteloua eriopoda*). The most common trees are juniper *(Juniperus monosperma)* and pinyon pine (*Pinus edulis*). For this report, we have included isolated patches of grassland found west of the town of Quemado in Catron County. The vegetation in these areas is similar to that found in the Plains of San Agustin. Land ownership in this study area is a mix of private, state, United States Forest Service, and BLM. The dominant land use is livestock grazing.

Estancia Valley Study Area

The Estancia Valley is a closed basin in central New Mexico, east of the Sandia and Manzano mountains, and west of the Pedernal Hills. The area extends north to the Galisteo Valley, and south to Chupadera Mesa. It is a closed basin of approximately 5,120 square kilometers. The dominant vegetation types are Juniper Savanna, Plains-Mesa Grassland, Closed Basin Scrub, Pinyon-Juniper woodland, and cultivated agricultural fields (Dick-Peddie 1993). The dominant grass in the area is blue grama. Widely scattered juniper trees are common, and some exotic deciduous trees also occur that are associated with abandoned homesteads and private homes. Ownership in the valley is largely private with land use including livestock grazing and agriculture. The majority of private land is sub-divided into small fenced pastures. The survey area is located in Torrance County, which has experienced a large increase in human population growth in recent years.

METHODS

In 2004, HAI conducted aerial surveys on 15 April (Farmington), 10 April (Estancia Valley) and 6, 9 April (Socorro). A minimum of two observers accompanied the pilot in a Cessna 205 fixed wing aircraft. Air speed during surveys averaged 169 kilometers per hour, and the altitude above ground ranged from 90-250 meters. The primary purpose of these surveys was to determine occupancy at known nest sites. When a new nest was located (occupied or not), its location was marked using a Garmin 92 Global Positioning System (GPS) designed for use in aircraft. HAI conducts transect flights every other year (or as funding allows) in most study areas to search for new or undocumented nests in previously un-surveyed areas. Transect flights were not conducted during 2004, and are scheduled to occur again in 2005.

A nest was considered to be “occupied” by an egg-laying pair (i.e. "breeding attempt") if:

- a bird was observed in the incubating position;
- eggs were observed in the nest;
- young were observed in the nest.

For the remainder of this report, the terms “occupied”, “breeding attempt (BA)” and “egg-laying pair” are used interchangeably. If none of these parameters were observed, the nest was considered unoccupied. If a bird was seen at or near the nest structure, and none of the above guidelines were met, the nest status was termed “tended”, and a subsequent ground survey was conducted to determine occupancy status. Private landowners denied ground access to some nests, all of which were located in the Estancia Valley and Socorro study areas. The breeding success of these nests were labeled “unknown” and were not included in analyses of breeding success or productivity.

The purpose of the aerial surveys was to document nest occupancy during the incubation period. Following the initial occupancy survey, we visited each occupied nest a minimum of two times to determine breeding success and productivity. We considered a nest to be successful if it fledged at least one nestling, and nestlings were determined to be fledged when they reached 80% of their fledging age, or approximately 32 days (Steenhof 1987).

We recorded the nest substrate of occupied nests to determine the effect of substrate on productivity and breeding success among egg-laying pairs. We also noted the rate of nest re-occupancy.

Due to increased concern about the ongoing drought and the impact that human disturbance could have on the productivity of Ferruginous Hawks, we did not band any nestlings during the 2004 breeding season. Our study methods minimized disturbance to the birds during the entire nesting season (Fyfe and Olendorff 1976).

To further document a potential correlation between precipitation levels and Ferruginous Hawk breeding success, we collected precipitation data from the Western Regional Climate Center website found at: http://www.wrcc.dri.edu/summary/climsmnm.html. (Appendix 1). We chose weather stations based on their proximity to centers of high nest density and the consistency of the data collected (i.e. least number of missed days). We used the Chaco Canyon National Monument (Farmington Resource Area), Augustine 2E (Socorro Resource Area), and Estancia (Estancia Valley Area) weather stations. The amount of precipitation for each year includes the monthly totals from July of the preceding year through June of the nesting year.

Up until 2004, as a result of problems in determining current land ownership, no distinction was made between occupied Ferruginous Hawk nests on BLM owned land and nests on non-BLM owned land in the Socorro study area; therefore, for 2004 data we produced metrics for nests on “BLM administered lands” and nests on “other” (non-BLM) lands to address the current needs of BLM land managers, while also providing an overall view of Ferruginous Hawk population parameters in New Mexico. Land ownership for the Socorro Field Office was determined by using the public land survey system and the most recent BLM-issued 1:100,000 management maps.

RESULTS

Individual nest summary data are presented in Appendix 2. Table 1 summarizes breeding success in the three HAI study areas. Three of five breeding attempts by Ferruginous Hawk pairs on BLM land (where the outcome was known) were successful in fledging at least one young, while 22 of 30 breeding attempts (outcome known) on non-BLM owned land in New Mexico were successful.

Table 1: Number of egg-laying pairs of Ferruginous Hawks, and breeding success by study area for 2004.

Study Area	Farmington		Socorro		Estancia	Total		Combined Total
Land Ownership	BLM	Other	BLM	Other	Other	BLM	Other	BLM and Other
# of Egg-Laying Pairs (ELP)	2	6	3	9	18	5	33	38
ELP Breeding Success Unknown	0	0	0	1	2	0	3	3
# of Successful ELP	2	3	1	5	14	3	22	25
# of Failed ELP	0	3	2	3	2	2	8	10
# of Tended Nests	0	0	2	2	0	0	4	4
# of Fledged Young	3+	8	3	12	34	6	54	60
# of Fledged Young per ELP (outcome known)	1.5	1.33	1	1.5	2.13	1.2	1.8	1.71

Figure 1 shows breeding success for Ferruginous Hawk pairs (outcome known) for all HAI study areas in New Mexico. These data are discussed in the results section for each individual study area.

Figure 1: Ferruginous Hawk Breeding Success in each HAI Study Area (outcome known, 2004).

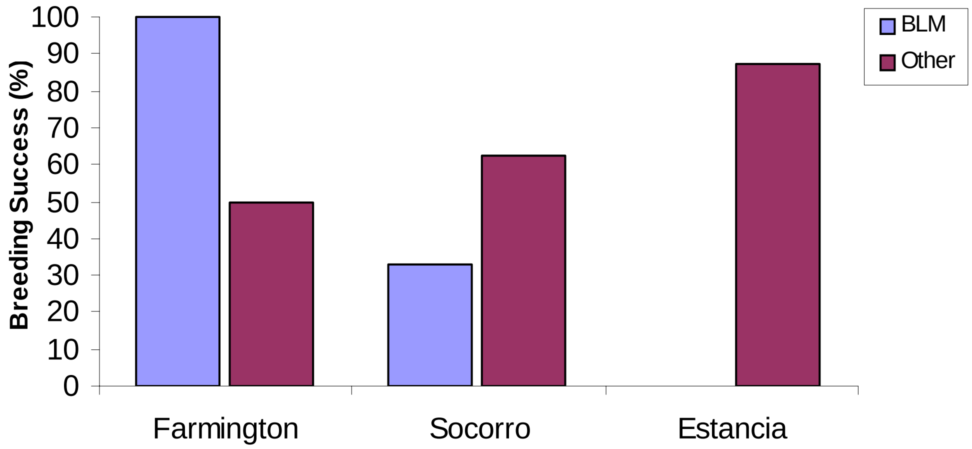


Figure 2 shows that egg-laying pairs on non-BLM owned land (n=30, outcome known) in New Mexico produced 1.8 young per breeding attempt while those on BLM owned land (n=5) produced 1.2 young per breeding attempt. Overall, in 2004, Ferruginous Hawk breeding success per occupied nest (outcome known) was 71%, while productivity averaged 1.71 young fledged per breeding attempt.

Figure 2: Ferruginous Hawk Productivity in New Mexico on BLM and Non-BLM Owned Land (2004).

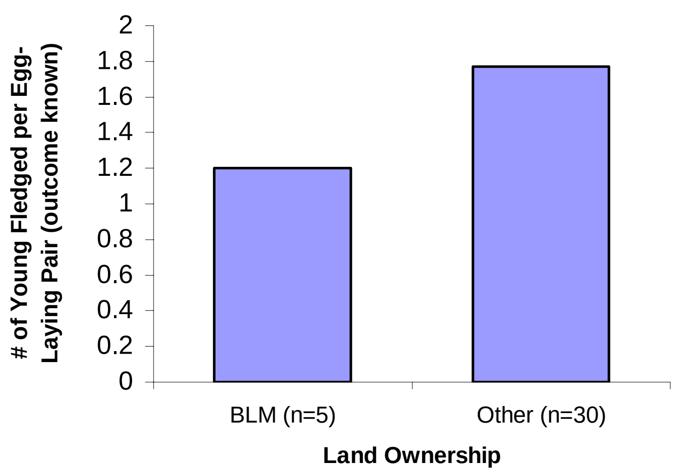
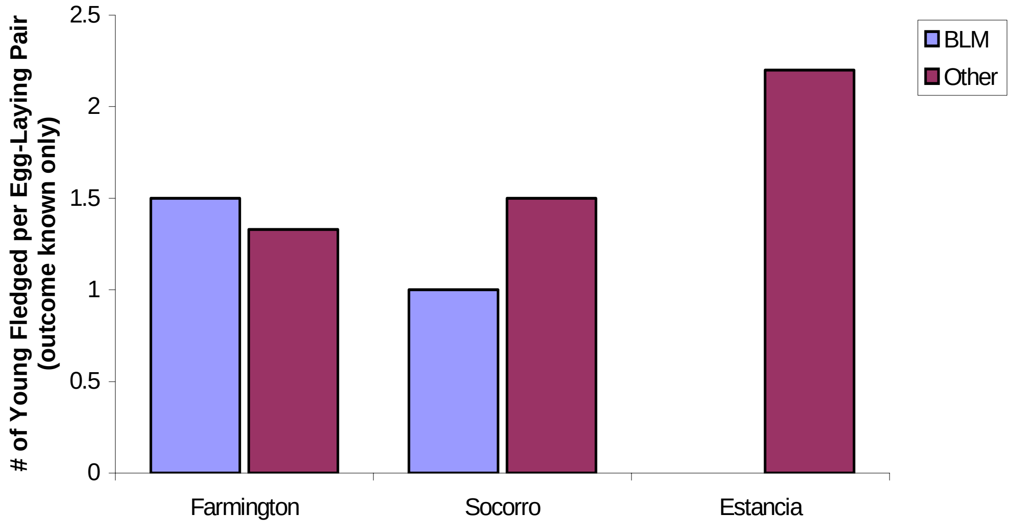


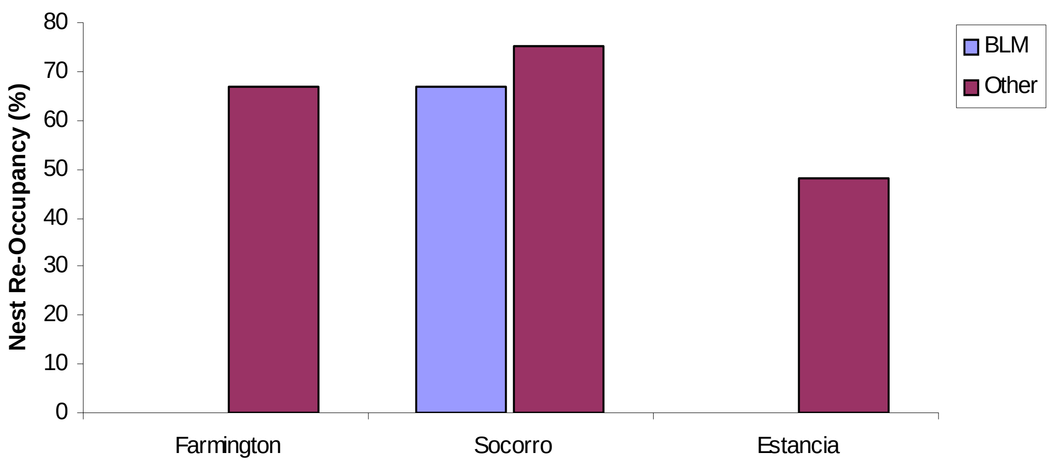
Figure 3 shows Ferruginous Hawk nest productivity in each of the HAI study areas for BLM and non-BLM managed land. These data are discussed in the results section for each study area.

Figure 3: Ferruginous Hawk Productivity in each HAI Study Area (outcome known, 2004).



The percentage of re-occupied nest sites from 2003 to 2004 (Appendix 2) was determined for all study areas, for BLM and non-BLM managed land (Figure 4). These data are discussed in the results section for each study area.

Figure 4: Ferruginous Hawk Nest Re-Occupancy in each HAI Study Area (2003-2004).



The effect of nest substrate on breeding success and average young fledged per nest in three study areas across New Mexico is shown in Table 2.

Table 2: Number of breeding attempts of Ferruginous Hawks, and breeding success by study area for various nest substrates (outcome known).

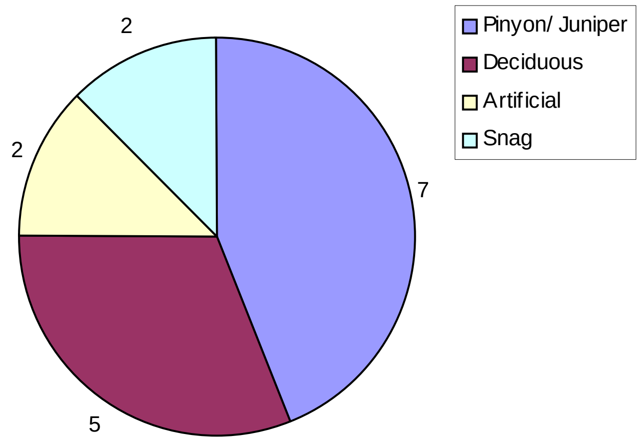
	Estancia Valley Study Area			**Farmington Study Area**			**Socorro Study Area**		
Nest Substrate	# of breeding attempts	% Breeding success	Av. # fledged per nest	# of breeding attempts	% Breeding success	Av. # fledged per nest	# of breeding attempts	% Breeding success	Av. # fledged per nest
Pinyon Pine	1	100	4	0	--	--	2	50	1.5
Juniper	6	83	2	0	--	--	6	50	1.3+
Deciduous Tree	5	100	2.4	0	--	--	0	--	--
Artificial Structure	2	100	1.5	0	--	--	0	--	--
Snag	2	50	1.5	0	--	--	3	67	1.3
Rock Spire	0	--	--	2	100	1.5	0	--	--
Bluff	0	--	--	6	50	1.33	0	--	--
Combined Total	**16**	**87.5**	**2.13**	**8**	**62.5**	**1.38**	**11**	**54.5**	**1.36+**

<u>Estancia Valley Study Area</u>

Eighteen pairs of Ferruginous Hawks attempted to breed in 2004 (Table 1), including two pairs that occupied previously undocumented nests. All nests in the Estancia Valley were located on private or New Mexico State owned lands. Landowners granted permission to monitor 16 of these pairs, of which 87% (n=14) bred successfully (Figure 1). Two pairs failed to produce young. Productivity for the Estancia Valley was higher than both of the other two study areas, with an average of 2.13 young per breeding attempt (Figure 3).

For this study area, the nest re-occupancy rate from 2003 to 2004 was 44% (Figure 4). Table 2 and Figure 5 shows that in 2004, pinyon pine (n=1) and juniper (n=6) were the nest substrate for 44% of the breeding attempts, while deciduous trees (n=5) were the nest substrate for 31% of the breeding attempts in which the outcome was determined. Snags were the substrate for two nests, while one nest was located on a power pole, and one on an artificial nest platform (artificial nesting structures).

Figure 5: Ferruginous Hawk Nesting Substrates in the Estancia Valley, 2004.



The breeding success rate for nests located on pinyon pine, deciduous trees, and artificial nest platforms was 100%, while 83% (n=5) of the nests on juniper were successful. Only 50% (n=1) of the nests located on snags were successful.

Farmington Study Area

Eight pairs of Ferruginous Hawks attempted to breed in this study area (Table 1). Two nests were located on BLM managed lands, and six were located on private lands. Five of these (63%) were successful, fledging a total of 11 young (Table 1), with an average of 1.38 young fledged per breeding attempt. Two pairs nested on rock spires, while six pairs located their nests on a bluff (Table 2).

BLM Owned Land

We documented two breeding attempts by Ferruginous Hawks on BLM owned land (Table 1). Both of these attempts were successful (Figure 1), and at least three young fledged, producing an average of 1.5 young per breeding attempt (Figure 3). Both of these pairs chose rock spires as their nesting substrate (Appendix 2). Neither of these nests was occupied in 2003; therefore, there was no nest re-occupancy. This study area had the lowest occupancy rates recorded by HAI in the past seven years (Appendix 3).

Non-BLM Owned Land

There were six breeding attempts by Ferruginous Hawks on non BLM-owned land in this study area (Table 1). Of these attempts, 50% of the nests were successful (Figure 1) producing a total of eight young, an average of 1.33 young fledged per breeding attempt (Figure 3). All of the breeding attempts occurred on bluffs (Appendix 2). Four (67%) of the nests occupied in 2004, were also occupied in 2003 (Figure 4).

Socorro Study Area

We documented 12 breeding attempts by Ferruginous Hawks on all lands surveyed in the Socorro study area (Table 1), including two attempts at previously undocumented nests. Three nests were located on BLM managed lands, and nine were located on private lands. Landowners granted access to monitor 11 of these nests, of which six (55%) were successful. A total of 15 young were produced, an average of 1.36 young per breeding attempt (Table 2). Six breeding pairs of Ferruginous Hawk (55%) chose juniper trees as their nesting substrate, two chose pinyon pine (18%), and three (27%) occupied a nest located in a snag (Table 2). Eight egg-laying pairs of Ferruginous Hawks (73%) occupied a nest that also had been occupied in 2003 (Appendix 2). Fifty percent of the nests located on junipers (n=3) were successful, fledging an average of 1.3 young per breeding attempt. Fifty percent of the nests located on pinyon pines (n=1) were successful, fledging an average of 1.5 young per breeding attempt. Two (67%) nests located on snags were successful, fledging an average of 1.3 young per breeding attempt.

BLM-Owned Land

We documented three egg-laying pairs on BLM owned land in this study area (Table 1). Only one nest (33%) was successful (Figure 1), and it fledged 3 young. Ferruginous Hawk productivity on BLM owned land in the Socorro study area was an average of one young fledged per breeding attempt (Figure 3). All Ferruginous Hawk pairs that attempted to breed at nests located on BLM owned land chose either pinyon pine or juniper trees as their substrate (Appendix 2). Sixty-seven percent (n=2) of the nests that were occupied in 2004 also were occupied in 2003 (Figure 4).

Non-BLM Owned Land

There were nine breeding attempts by Ferruginous Hawks on non-BLM owned lands within this study area (Table 1), including two pairs at previously undocumented nests. Landowners granted access to HAI to monitor eight of these nests, of which 63% (n=5) successfully fledged a total of 12 young (Figure 1). Productivity for these nests was 1.5 young fledged per breeding attempt (Figure 3). Juniper was the preferred substrate (n=4) for Ferruginous Hawk pairs in this area (Appendix 2), while three pairs nested on snags and one nested on pinyon pine. Seventy-five percent (n=6) of nests that were occupied in 2004 were also occupied in 2003 (Figure 4).

Combined data: 1998-2004

Surveys have been conducted by HAI for the past seven years. Data for Ferruginous Hawk breeding attempts from 1998 to 2004 are presented in Appendix 3.

When 2004 data are combined with HAI annual data from 1998 until 2003 (summarized in Appendix 4), we find that Ferruginous Hawk pairs within all three of the study areas in New Mexico fledged an average of 1.66 young per breeding attempt (n=259). Ferruginous Hawks in the Estancia Valley were the most productive, with an average of 1.9 young fledged per breeding attempt (n=131); Socorro pairs fledged an average of 1.46 young per breeding attempt (n=99), and Farmington (BLM land only) pairs fledged an average of 1.14 young (n=29).

Combined data (1998-2004) showing percentage breeding success for Ferruginous Hawks in each HAI study area are presented in Appendix 5.

DISCUSSION

Breeding Attempts, Breeding Success, and Productivity

The number of breeding attempts decreased in each study area from 2003 to 2004 (Appendix 2). In Farmington and Socorro, the number of egg-laying pairs recorded in 2004 was at a seven-year low. In the Socorro study area however, we observed four adult Ferruginous Hawks near known nests on different visits. We observed one non-breeding pair in the vicinity of the same nest on four separate occasions. The proximal nests were empty during all observations and no sign of any breeding attempts were observed (i.e. fledglings in the area). The continuous presence of adults in the same areas suggest that these were non-breeding adults who remained near their historic nesting territories.

We documented disturbances to two breeding pairs of Ferruginous Hawks on BLM land within the Socorro study area that might have impacted their breeding success. On 29 June 2004, a thunderstorm deposited an inch of rain near Quemado, New Mexico (J. Williams, pers. comm.). A subsequent check of the nest ("QM-01-FH") on 1 July 2004 found two dead chicks in the nest that were approximately 20 days old. The nest was observed a few days prior to the storm and both nestlings were alive. It is possible that this weather-related event caused the nestlings feathers to become too wet, resulting in death by hypothermia.

We recorded another potential human disturbance at nest "SG-05-FH". An adult in incubating posture was observed on this nest during aerial surveys on 9 April 2004. The subsequent ground check found a vacated nest and truck tire tracks around the base of the tree in which the nest was located. This is the same nest where an adult female Ferruginous Hawk was shot and killed while it was incubating five eggs in 2003.

Although the number of breeding attempts declined in the Estancia Valley and the Farmington study areas (on BLM lands only) from 2003 to 2004, both study areas had the highest overall breeding success rate recorded from 1998-2004 (Figure 1 and Appendix

5). Of particular interest, is the continued breeding success of Ferruginous Hawks in the Estancia Valley; over 70% for five of the last six years. Furthermore, Ferruginous Hawks in the Estancia Valley fledged the greatest number of nestlings per breeding attempt of all study areas in 2004, an average of 2.13 young per egg-laying pair (Table 1). This trend is consistent for four of the six years between 1998 and 2003 (Appendix 4). In addition, the Estancia Valley has consistently had the highest density of active nests and breeding attempts of all study areas.

The Estancia Valley is increasingly being converted to four to ten acre ranchettes that are fragmenting the landscape and reducing suitable Ferruginous Hawk habitat into small pockets. Bechard *et al*. (1990) and Holmes (1994) noted the species' wary behavior and overall sensitivity to humans. Yet, the data do not show the predicted decline in any of the measured Ferruginous Hawk breeding parameters. These anthropogenic encroachments are fairly recent; we may not see any decline in population demographics for several years (Roth and Marzluff 1986). The prime reason for pairs remaining in the Estancia Valley could be the availability of the Ferruginous Hawk's preferred prey source, Gunnison's prairie dog (*Cynomys gunnisoni*) (Hawks Aloft, Inc. 2000).

In areas of abundant nesting habitat, low food availability can limit raptor populations (Newton 1979) and may be correlated with the presence of non-breeding adults (Olendorff 1993, Ensign 1983). In the Estancia Valley, Cook *et al*. (2003) noted a positive spatial relationship between occupied Ferruginous Hawk nests and active Gunnison's prairie dog towns. In 2004, we located 20 Gunnison's prairie dog towns on BLM land in the Socorro study area, with an average size of 35 acres (Hawks Aloft, Inc. 2004). In the Estancia Valley in 2004, we located 26 Gunnison's prairie dog towns, which averaged 60 acres in size. The dearth of available prey in the Socorro study area could explain the reduction in breeding attempts by Ferruginous Hawk in that area.

Although Steenhof and Kochert (1985) documented Ferruginous Hawks changing their main source of prey in years of low prey abundance, the species is still considered a dietary specialist (Bechard and Schmutz 1995). These types of predators tend to show a 'numeric' response to low food availability (Restani *et al*. 2000, Rohner 1995); that is, when prey numbers are low, they leave the area and move to a new location with more abundant resources (i.e. nomadism), or they remain in the area but do not attempt to breed (Smith and Murphy 1979, Schmutz and Hungle 1989, Cully, Jr. 1991). Leary *et al*. (1998) found that Ferruginous Hawks significantly expand their home range in years of low food availability. Therefore, management practices that enhance or maintain an adequate prey base for Ferruginous Hawks can be an effective tool in managing the long-term success of the species (Olendorff 1993).

Precipitation and its effect on prey populations may be an important factor in determining raptor breeding success (Steenhof *et al*. 1997). More recently, evidence has accumulated that indicates the current ongoing drought affecting the interior western United States is leading to increased raptor mortality (Hoffman and Smith 2003). Since 2001, the drought conditions that have occurred in New Mexico (Appendix 1) may be affecting raptor nesting success.

Woffinden and Murphy (1989) estimated that each breeding pair of Ferruginous Hawks need to fledge at least 1.5 young annually to maintain a stable population, assuming 66% first year mortality and 25% adult mortality. Using this parameter as a guide, and taking combined data from 1998-2004 into account, the status of the Ferruginous Hawk population in the Estancia Valley study area appears to be stable, while populations in the Socorro and Farmington may be declining.

Nesting Substrate

Availability of nest sites is a potential limiting factor for raptor population growth (Newton 1979). This is especially valid for the Ferruginous Hawk, which often inhabits grasslands with few trees, has an affinity for nesting in lone junipers or in junipers located on grassland edges, and generally avoids areas of denser woodland (Bechard and Schmutz 1995). Hence, data on nesting substrate choice can be an effective tool in managing or augmenting Ferruginous Hawk populations. Olendorff and Stoddart (1974) recommended protecting all nesting substrates, especially lone junipers that might be damaged by cattle. Alternatively, many studies indicate that artificial nesting structures (ANS) are an effective management tool for stabilizing Ferruginous Hawk numbers. Tigner *et al*. (1996) reported that 80-100% of pairs laying eggs on an ANS successfully fledged young, while Steenhof *et al*. (1993) noted that Ferruginous Hawks nesting on power poles had a higher success rate than pairs nesting on natural substrates. Our data support this finding; one nest was located on a power pole and one on an ANS in the Estancia Valley study area. Both of these were successful in fledging young.

Providing adequate nesting substrates for Ferruginous Hawks is one of the most effective management techniques available to land managers. This was the topic of much discussion during the recent Ferruginous Hawk conservation workshop in Boise, Idaho. Installation of ANS have proven to be an effective method for mitigating habitat conversion from tree/shrub communities to grass/shrub communities or initiating occupancy of an area with an abundant source of prey (Schmutz *et al*. 1984, Houston 1985). Ferruginous Hawk breeding success on an ANS exceeded that of nests located on natural substrates in many states. For instance, Ferruginous Hawks in Idaho that nested on ANS experienced a breeding success rate of 82%, compared to 50% for nests on natural substrates (M. Kochert, pers. comm.). Also, breeding areas in Idaho with ANS experienced higher nest re-occupancy rates than those with only naturally available substrates. In Wyoming, BLM wildlife biologists installed ANS to partially mitigate for Ferruginous Hawk nest failures resulting from disturbance caused by repair of condensation tanks associated with natural gas extraction (M. Neal, pers. comm.). In both instances, biologists suggested that the ANS provide more secure, and safer nesting structures than natural substrates, which could explain the increase in breeding success for Ferruginous Hawks utilizing these structures. Theoretically, a safer nest increases the likelihood that both adults will hunt, thereby increasing prey biomass delivered to nestlings and, ultimately, increasing nesting success.

In this study, all surveyed areas showed variations in nesting substrate choice by Ferruginous Hawk. Although there were no significant differences in breeding success and productivity among nesting substrates within study areas, it is important to note changes in substrate choice by Ferruginous Hawk pairs in order to facilitate identification of population trends. In the Estancia Valley study area, deciduous trees planted by homesteaders and farmers in the otherwise unbroken, grasslands seem to be especially important to Ferruginous Hawks. In 2004, occupation of nests on deciduous trees was 31% (n=5) with a success rate of 100%. In the same area, breeding attempts on ANS was 13% (n=2) with a 100% success rate. In 2004, Hawks Aloft, along with Central New Mexico Electric Co-op, installed an ANS to replace an electrical transformer that supported an active Ferruginous Hawk nest, after the breeding season. Additionally, HAI installed several ANS on a section of private land in the Estancia Valley in 1997. One of these ANS has been occupied by Ferruginous Hawks for two of the past seven years (Appendix 2).

<u>Nest Re-occupancy</u>

In 2004, the highest nest re-occupancy rate occurred in the Socorro study area, where almost three of four nests were re-occupied from 2003 to 2004. The low availability of nest sites is one factor that leads to the repeated use of a single nest site. Nest re-occupancy is common in many bird species (e.g. waterfowl, woodpeckers, passerines, and raptors) with pairs tending to re-occupy areas where they have bred successfully in the past (Gowaty and Plissner 1997, Haas 1998). This was observed at one nest in the Estancia Valley located in a deciduous tree ("MN-03-FH") that has supported a successful breeding pair every year for the past seven years (Appendix 2).

In 2004, Ferruginous Hawks in the Socorro study area had a high rate of nest re-occupancy and, although almost 50% of the birds did not attempt to breed, they still showed signs of site fidelity. These factors make the Socorro study area a good choice for the installation of ANS to draw birds to areas of higher prey density and to provide more secure nesting structures. Some of these nest platforms could be built in close proximity to newly discovered Gunnison's prairie dog towns (Hawks Aloft, Inc. 2004), on which Ferruginous Hawks in New Mexico regularly prey (Ligon 1961, Cully, Jr. 1991, Cook *et al*. 2003).

RECOMMENDATIONS

The management of Ferruginous Hawks and their associated habitats must be based upon adequate nest substrates, stable and sufficient food resources, and freedom from direct or prolonged disturbance. Effective evaluation of these factors should help determine the optimal placement of an ANS and help to maintain long-term population stability. Considering the known threats to Ferruginous Hawk breeding success, proactive, coordinated research and management are needed to conserve this species. We recommend the following:

1. All accessible Ferruginous Hawk nests should be monitored in order to effectively document changes in population trends.
2. Land managers and wildlife biologists should continue to be aware of the current status of the Ferruginous Hawk and any changes observed in the population status should be addressed in a management plan.
3. Artificial nesting structures should be erected in suitable habitats. The Socorro study area provides an excellent opportunity to manage Ferruginous Hawk populations using ANS. We recommend installing ten ANS in 2005 during the non-breeding season at specified locations in an attempt to attract birds onto BLM-managed land, provided that there is a sufficient prey base and minimal disturbance. This would help mitigate problems associated with human persecution of this species.
4. In areas where resource extraction permits will be issued, efforts should be increased to identify raptor use of the area and identify areas of critical concern, well in advance of resource extraction activities. Buffer zones should be placed around occupied and unoccupied raptor nests according to the duration and proximity of the disturbance to the nest, in an attempt to avoid nest abandonment

caused by human related activities. Guidelines for these buffer zones can be reviewed in Romin and Muck (2002).

5. Efforts should be increased to identify major prey items taken by Ferruginous Hawks and initiate techniques to estimate prey abundance within Ferruginous Hawk habitat. It is clear that Ferruginous Hawk breeding success and productivity is correlated with food abundance. Efforts should be supported to gather data concerning prey abundance so that the effect on hawk populations can be more effectively documented.
6. If land is converted from tree/shrub communities to grassland/shrub communities, efforts should be made to protect individual trees, a mosaic stand of trees, or a thin scattering of trees as nest substrates for Ferruginous Hawk (Howard and Wolfe 1976, Murphy 1978). ANS installment should also be considered during mitigations such as habitat conversion and oil and gas leasing.
7. Snags that hold nests should be stabilized or reinforced to keep them functional for as long as possible. ANS installation within close proximity of once-occupied snags can also be an effective method of optimizing breeding success.

PERSONNEL

This report was prepared by Will Keeley, and edited by Ron Kellermueller, Sarah Young and Gail Garber. Seamus Breslin, Ron Kellermueller, and Will Keeley conducted the field work. Seamus Breslin, Gail Garber, Ron Kellermueller and Lorraine McInnes conducted the aerial surveys. Jerry Hoogerwerf, of Socorro Air Taxi, piloted the Cessna 205 aircraft and assisted with observations for all aerial surveys. Cover photo by Will Keeley.

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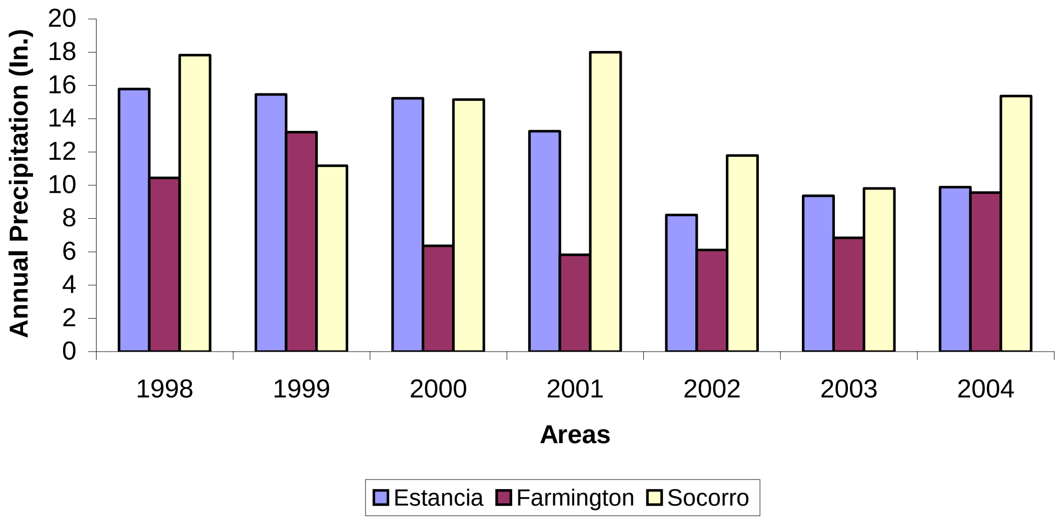
APPENDICES

Appendix 1: Annual precipitation for Estancia, Farmington, and Socorro study areas, New Mexico (1998-2004).



Appendix 2: Ferruginous Hawk Nest Data in all HAI Study Areas (1998-2004).

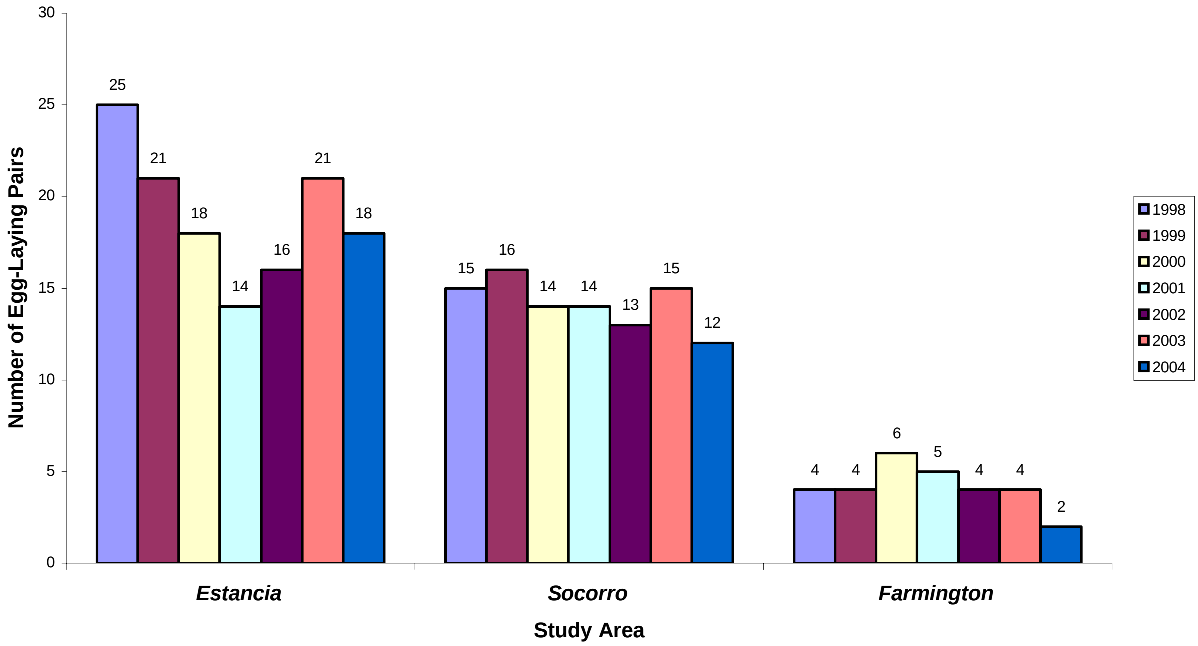
Study Areas	Ownership	HAI Nest #	BLM Nest #	Successful	# Fledged in 2004	Nest Substrate	Years Occupied
Farmington Resource Area	BLM	AW01FH	118	Y	2+	Rock Spire	2004
		AE03FH	32	Y	1+	Rock Spire	2004
	Other	n/a	29	Y	2	Bluff	2004
		n/a	45	Y	2	Bluff	2004
		n/a	205	Y	4	Bluff	2002-04
		n/a	206	N	0	Bluff	2002-04
		n/a	213	N	0	Bluff	2002-04
		n/a	220	N	0	Bluff	2003-04
Socorro Resource Area	BLM	SG-05-FH		N	0	Juniper	2003-04
		TS-01b-FH	597	Y	3	Pinyon	1998-2001; 2004
		QM-01-FH		N	0	Juniper	2003-04
	Other	AG-01-FH		N	0	Juniper	2002-04
		AG-20-FH		N	0	Snag	2001-04
		AH-04-FH	599	Y	2+	Juniper	1998-1999; 2004
		LN-02-FH		N	0	Pinyon	2003-04
		MA-01-FH		Y	3	Juniper	2002-04
		MA-02-FH		Y	3	Snag	2003-04
		SG-06-FH*		Y	3	Juniper	2004
		LM-01-FH		Y	1	Snag	2003-04
Estancia Valley	Other	EW-05a-FH		Y	4	Pinyon	2004
		EW-07-FH		Y	1+	Artificial Platform	1999, 2004
		KD-02-FH		N	0	Snag	2001, 2004
		ME-02-FH*		Y	3	Snag	2004
		MN-02-FH		N	0	Juniper	1998, 2003-04
		MN-03-FH		Y	2	Deciduous	1998-2004
		MS-10-FH		Y	2+	Power Pole	2004
		RT-03-FH		Y	3	Juniper	2003-04
		SD-01-FH		Y	3	Deciduous	1998, 2002-04
		TR-02-FH		Y	3	Juniper	1998-2000, 2004
		TR-03-FH		Y	2	Deciduous	1998-2001, 2004
		TR-04-FH		Y	1	Juniper	1998, 2003-04
		TE-01-FH		Y	2	Juniper	2004
		MT-13-FH		Y	3	Deciduous	2003-04
		MT-14-FH		Y	2	Deciduous	2003-04
		MT-15-FH*		Y	3	Juniper	2004

n/a = not available

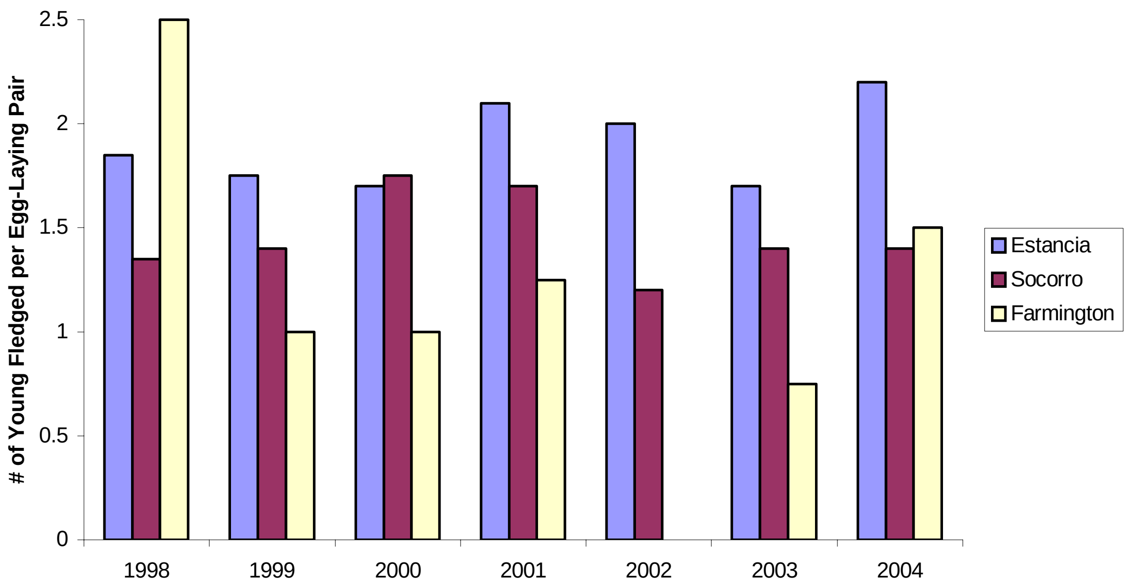
Y = Yes

N = No

Appendix 3: Number of Ferruginous Hawk Breeding Attempts in each HAI study area (1998-2004).



Appendix 4. Ferruginous Hawk Productivity (1998-2004). [Data for Socorro and Farmington is for BLM-owned land only, while Estancia Valley is for non-BLM-owned land].



Appendix 5: Ferruginous Hawk Breeding Success (1998-2004). [Data for Socorro and Farmington is for BLM-owned land only, while Estancia Valley is for non-BLM-owned land].