Ferruginous Hawk (*Buteo regalis*) Inventories on the Dillon Resource Area of Southwest Montana; 1992

by

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ABSTRACT

From June to August 1992, 42,890 ha of public and private land were surveyed in Beaverhead and Madison counties of southwest Montana for the presence of Ferruginous Hawks. Fifty nests were located, including 16 active nests (15 previously undocumented territories). With the addition of these active nests, the surveyed areas of southwestern Montana contain at least 132 active territories. Hawks chose a variety of substrates upon which to nest, primarily placing nests upon rocky outcrops (51.6%) in this high elevation population ($\overline{x}$ = 1888 ± 178.5 m). Nests were located near the apexes (65.39 ± 17.87%) of steep slopes (62.76 ± 40.15%) which predominantly exhibited a southern exposure (190.84 ± 62.45°). Habitat within 100 m of Ferruginous Hawk nests consisted of approximately equivalent proportions of grassland and shrubland, whereas grassland constituted over 50% of the vegetation within a 1.6 km circle centered at the nest. On average, territories contained 1.31 ± 0.92 alternate nests and active territories were separated by a mean of 1911 m (SD = 659.2 m). Density of breeding Ferruginous Hawks was highly variable throughout the study area ranging from 0 to 0.10 active territories per square kilometer ($\overline{x}$ = 0.04 ± 0.04 active territories/km^2). Fifty percent of the active and inactive nests were observed in the Sagebrush Steppe Association, whereas the Foothill Prairie Association contained 43.8 and 23.5% of the active

and inactive nests, respectively. Only 6.3 and 2% of the active and inactive nests, respectively, were located in the Mountain Mahogany Association. Productivity of Ferruginous Hawk nests was 1.9 $\pm$ 1.4 fledglings/territorial pair. Ground squirrels (Spermophilus spp.) accounted for 45.5% of identified prey items, whereas passerines made up nearly 20% of the diet of this population of Ferruginous Hawks. Vegetative diversity was measured surrounding 15 active nests from the Centennial Valley north to the Dillon area.

INTRODUCTION

The Ferruginous Hawk (Buteo regalis) is the largest buteo in North America and has been shown to be strongly associated with grasslands, and to a lesser extent, shrub steppe communities where open areas are available for foraging. Ferruginous Hawks historically nested over much of western North America (Figure 1). Many researchers have inferred or demonstrated that Ferruginous Hawk populations have declined through portions of their range and since 1982, this species has been classified as a Category 2 species by the United States Fish and Wildlife Service (USFWS) (Woffinden 1975, Oakleaf 1985, Powers and Craig 1976, Murphy 1978, Bechard 1981, Evans 1982, Houston and Bechard 1984, Schmutz 1984, Schmutz et al. 1984, Woffinden and Murphy 1989, USFWS 1992). In 1991, the USFWS was petitioned to list this species as "endangered" under the Endangered Species Act (Ure et al. 1991); a listing that was subsequently deemed unmerited due to the high variability within and between populations in terms of productivity and to the fact that the petition presented insufficient information to warrant such a listing (USFWS 1992) even though Ferruginous Hawks are currently considered a "threatened" species by the Canadian Wildlife Service (Johnsgard 1990). Much concern remains regarding the long-term viability of Ferruginous Hawks over much of their range.

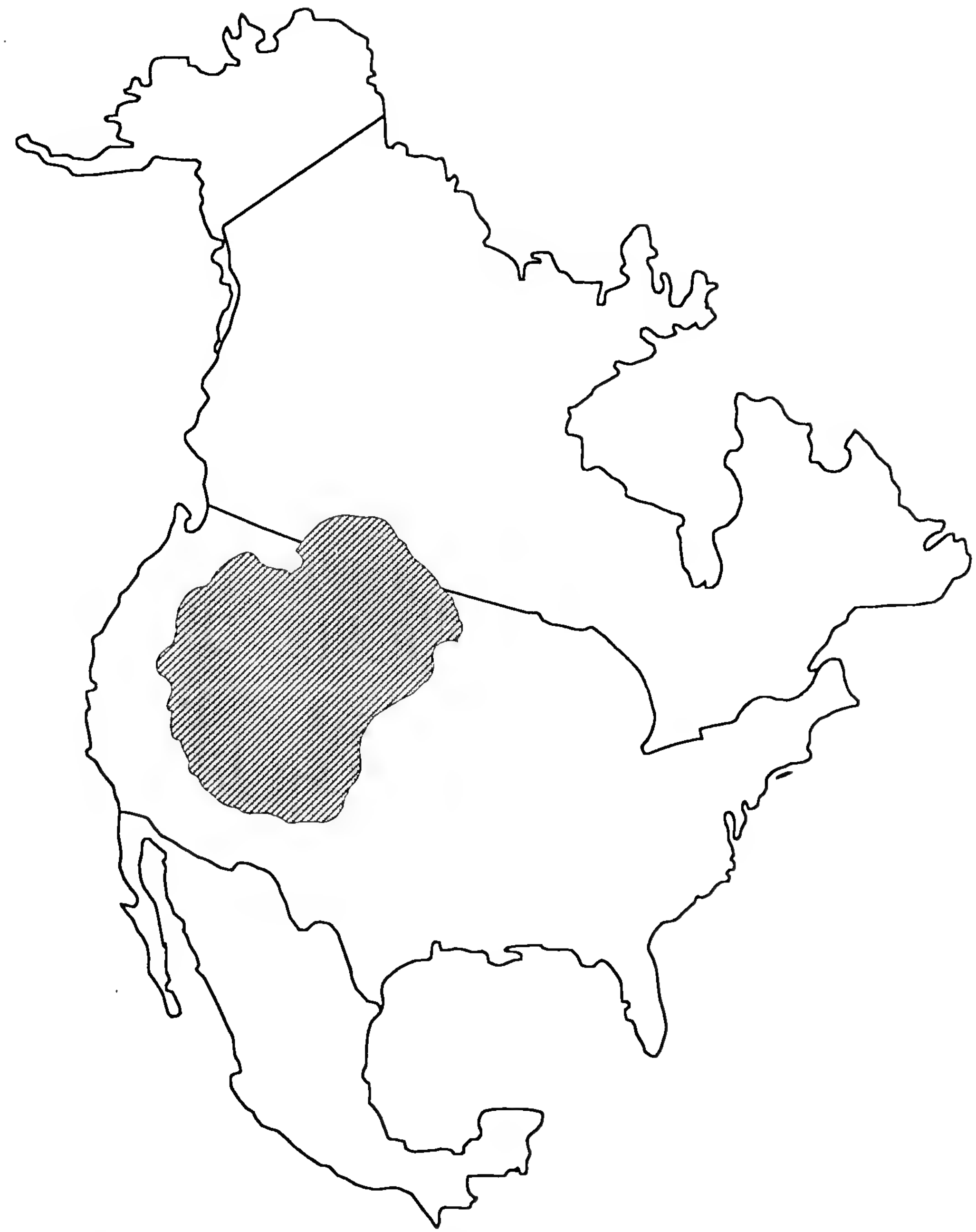

Figure 1. Historic breeding range of the Ferruginous Hawk in North America.

The state-wide status and viability of Ferruginous Hawks in Montana is poorly known with studies to date centered in extreme southeastern, extreme southwestern, and north-central Montana (Ensign 1983; Myers 1987; Restani 1989, 1991; Harmata 1991; Wittenhagen 1991). Montana appears to support a relatively stable population of breeding Ferruginous Hawks, second in size only to Wyoming in the United States (Ure et al. 1991, USFWS 1992). Myers (1987) documented a very high density of nesting pairs in Beaverhead and Madison counties, rivalled by few other populations region-wide. However, similar to other portions of its breeding range, apparently suitable habitat in southwestern Montana remains unoccupied by breeding Ferruginous Hawks (Fitzner et al. 1977, E. C. Atkinson pers. observ.) and the number of active territories has likely declined historically in Montana as a result of homesteading and the concurrent conversion of native grasslands to agriculture (Dennis Flath pers. comm.). Just to our north in Alberta, Ferruginous Hawks presently occupy only 60% of the area in which they historically nested, a situation that is strongly tied to increases in land area used for agriculture and the increases of woody species associated with fire suppression (Houston and Bechard 1984; Schmutz 1984, 1987a).

This study was a continuation of the surveys of public land in southwest Montana performed in 1985 and 1986 by

Lewis Myers [Bureau of Land Management (BLM), Dillon Resource Area]. The surveys that I performed in 1992 led to the completion of an inventory program for the majority of BLM holdings in Beaverhead and Madison counties, Montana (Figure 2).

METHODS

I initiated field surveys for nesting Ferruginous Hawks on 24 June 1992 and continued until 1 August 1992. Six major areas totalling 42,890 ha (105,900 acres) to be surveyed were delineated by Dillon Resource Area (BLM) biologist Jim Roscoe (Appendix A). Area boundaries were transferred to 7.5 minute U.S. Geological Survey (USGS) topographic maps for use in the field.

Surveys were conducted on foot by walking ridges while intermittently stopping to survey the surrounding areas for stick nests and hawks with 9X binoculars and/or 20X spotting scope. Additionally, some areas were surveyed via 4x4 truck, again, coupled with scanning through binoculars, often from exposed promontories. One aerial survey from a fixed-wing aircraft was performed on 16 July.

Locations of Ferruginous Hawk and other raptor nests were plotted on 7.5 minute quads and a "Raptor Nest Inventory" form (BLM) (Appendix B) was filled out for each Ferruginous Hawk nest observed. I categorized the substrate supporting the nest into the following: ground = nest

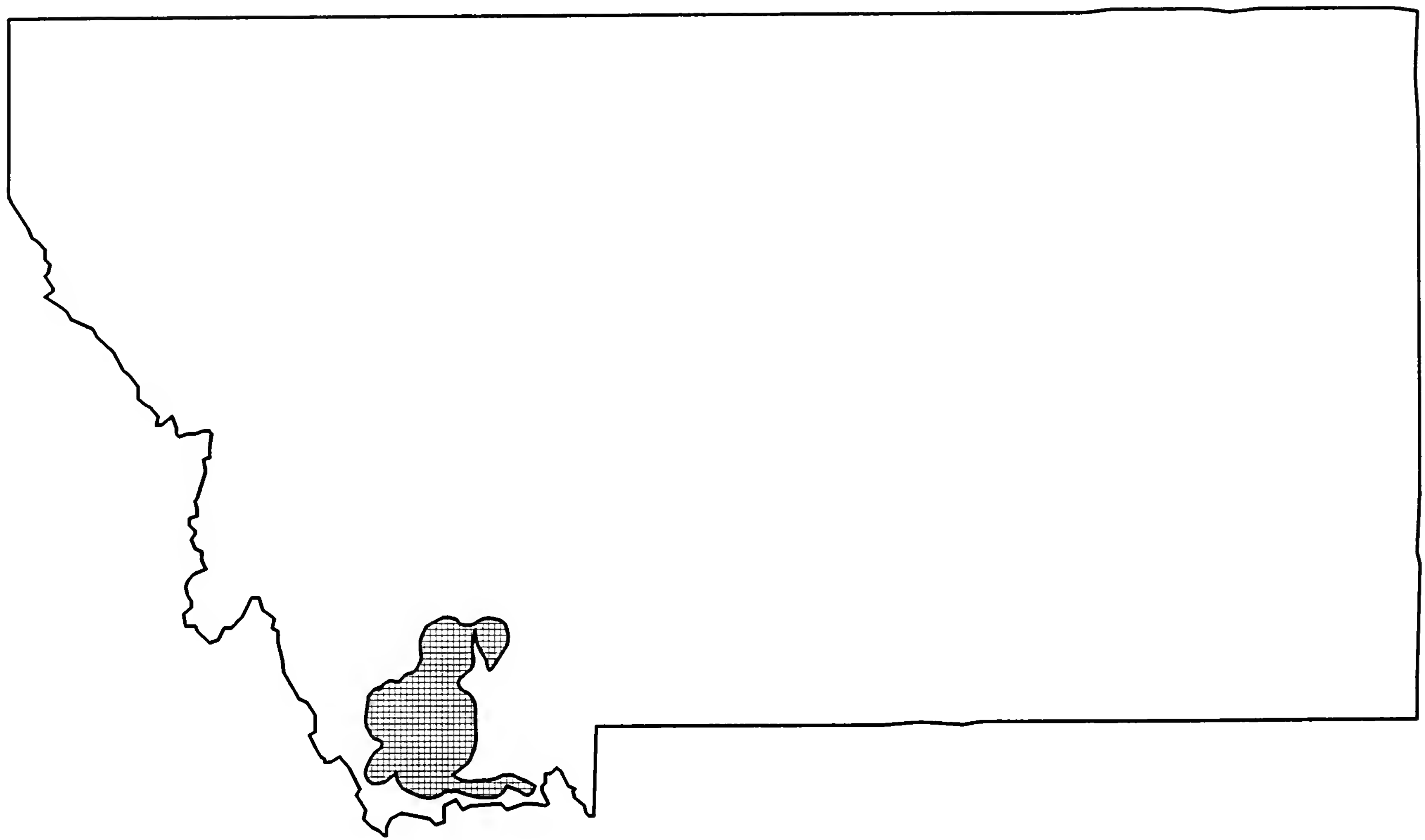

Figure 2. General location of the study area in southwest Montana.

situated directly (not elevated) upon the ground; outcrop = nest situated on a rocky outcrop, the size of which ranged from < 1m to several meters in height; rimrock or bluff = a linear escarpment or fault-line, smaller than a cliff and up to approximately 12m in height; cliff = less linear than rimrock and usually > 12m in height; tree = conifer or deciduous tree, or shrub; and power pole. The activity status of each nest was determined, number and approximate age of young were recorded, slope and aspect were measured, prey items were enumerated, and pellets were collected at each nest. Additionally, I visually estimated the percent cover and percent quantity of major vegetative cover types primarily including grassland, shrubland, and shrub/grass mosaic areas within a 100 m radius of the nest and within a 1.6 km (1 mile) radius of the nest. I determined the habitat association within which each nest occurred from maps located at the Dillon Resource Area office (Kuchler 1964).

Ferruginous Hawk pellets were dissected with a 10-30X dissection scope, prey items were identified, and prey were enumerated, corrected to the minimum number of individuals represented for each nest or collection date. Beetles (Carabidae and Scarabaidae) were treated as though they were incidentally ingested, hence, were not included in the analysis. Diet diversity was calculated for the complete study area (Ludwig and Reynolds 1988).

From 30 July to 1 August, botanical data surrounding 15 nests (active 1992) were recorded with the use of ECODATA methodology (Appendix C, DeVelice 1991). Shannon's index and Hill's numbers as measurements of diversity for plant species present within a 10.9 m radius surrounding each nest were calculated for each ECODATA plot (Ludwig and Reynolds 1988).

RESULTS

I found a total of 16 active Ferruginous Hawk nests while performing surveys. I also discovered 24 inactive nests over the course of the field season. Nests ranged in elevation from 1635 to 2286 m (5365 to 7500 feet) (x = 1887.8 m, SD = 178.5 m, n = 50). Legal descriptions of each nest with habitat associations are presented in Appendix D. Completed "Raptor Nest Inventory" forms are on file at the Dillon Resource Area office. Additionally, 11 active nests located in the Centennial Valley adjacent to our study area (Marco Restani, pers. comm.) were visited to record productivity and to describe nesting habitat. Locations of other raptor nests observed are listed in Appendix E.

Density of active territories was quite variable between the areas that were surveyed (Table 1). The two areas with highest Ferruginous Hawk breeding pair densities were the Frying Pan Basin and Diamond Butte areas, both of which contained a significant amount of private lands. The

Table 1. Areas surveyed, number of active territories, and densities of Ferruginous Hawks in southwest Montana.

AREA	# km^2	# ACTIVE TERRITORIES	km^2/ PAIR	#PAIRS /km^2
Armstead	77.7	0	----	0.00
Bannack	59.5	1	59.5	0.02
Block Mtn.	46.6	1	46.6	0.02
Diamond Butte	19.7	2	9.9	0.10
Frying Pan Basin	77.7	8	9.7	0.10
Henneberry	57.0	1	57.0	0.02
Sweetwater	44.1	1	44.1	0.02
Vinegar Basin	46.6	1	46.6	0.02
Total	428.9	15	28.6	0.04

average distance which separated active nests was 1911 m (SD = 659.15, n = 8) and I found that each active territory contained an average of 2.31 nests (including the active nest and any alternate nests) (SD = 1.92, n = 16). Eight territories contained the active nest only, whereas one territory contained seven alternate nests.

The single aerial survey proved to be quite efficient. During a period of two hours I located two Ferruginous Hawk nests in the approximately 7800 ha (19200 acres) surveyed. However, both nests were inactive. I subsequently surveyed the area on foot and by vehicle, discovering one additional inactive Ferruginous Hawk nest and an active Red-tailed Hawk nest from which young had recently fledged.

Ferruginous Hawks chose a variety of substrates for nesting, most commonly upon rocky outcrops (Figure 3). Other than those nests on cliffs or in trees, most were quite accessible from the ground, potentially accessible to ground predators. Nests were oriented nonrandomly with hawks preferring to orient their nests with a southern exposure [$\bar{x}$ = 190.84° , circular standard deviation = 76.94°, n = 48; Rayleigh's test, $\underline{z}$ = 7.91, $p < 0.0001$ (Zar 1974)] (Figure 4).

The slope upon which Ferruginous Hawks placed their nests was quite variable and the mean slope was quite high (x = 62.8%, SD = 40.2%, n = 50) (Figure 5). Most nests were

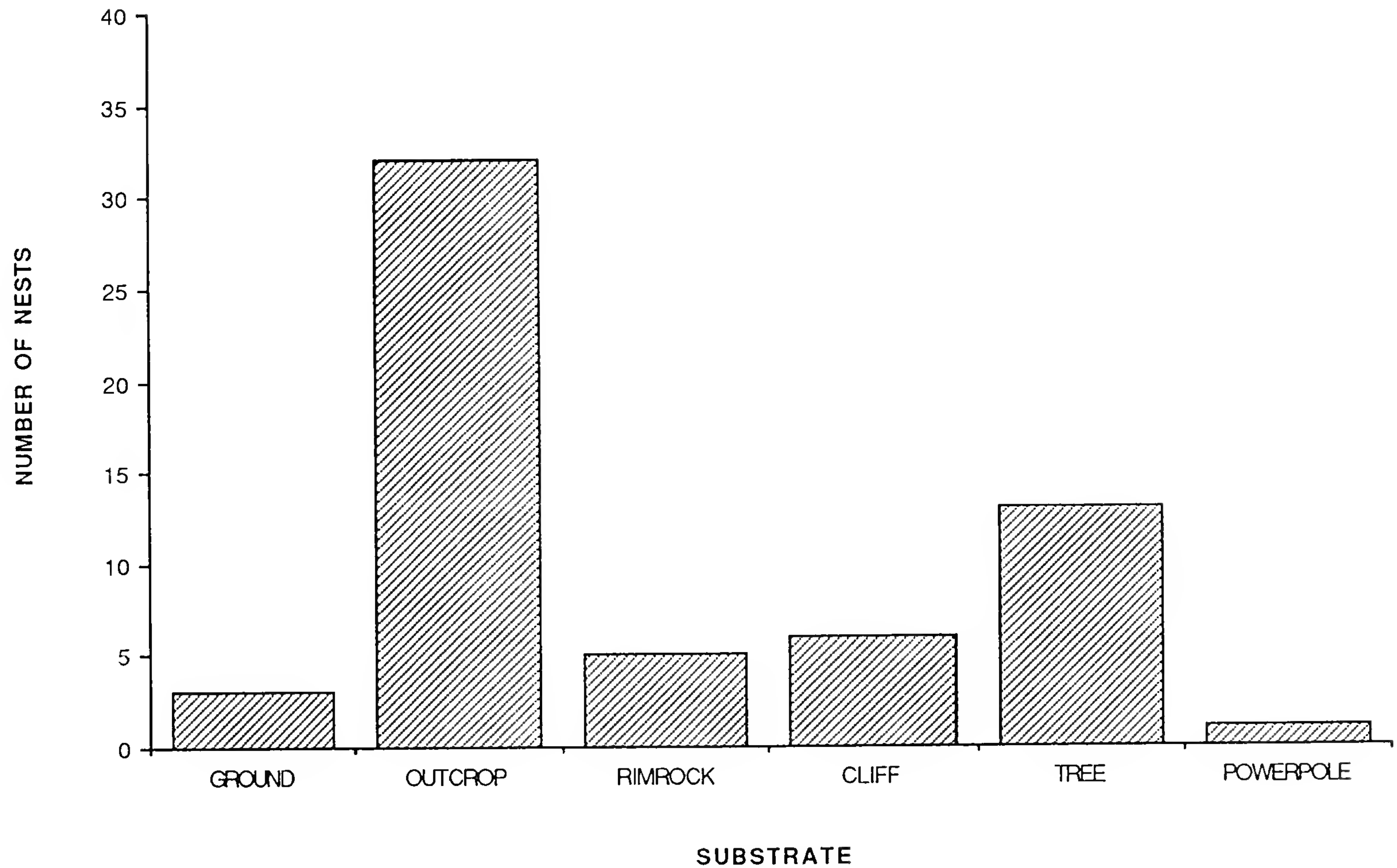

Figure 3. Substrates nested upon by Ferruginous Hawks in southwest Montana, 1992 (n = 60).

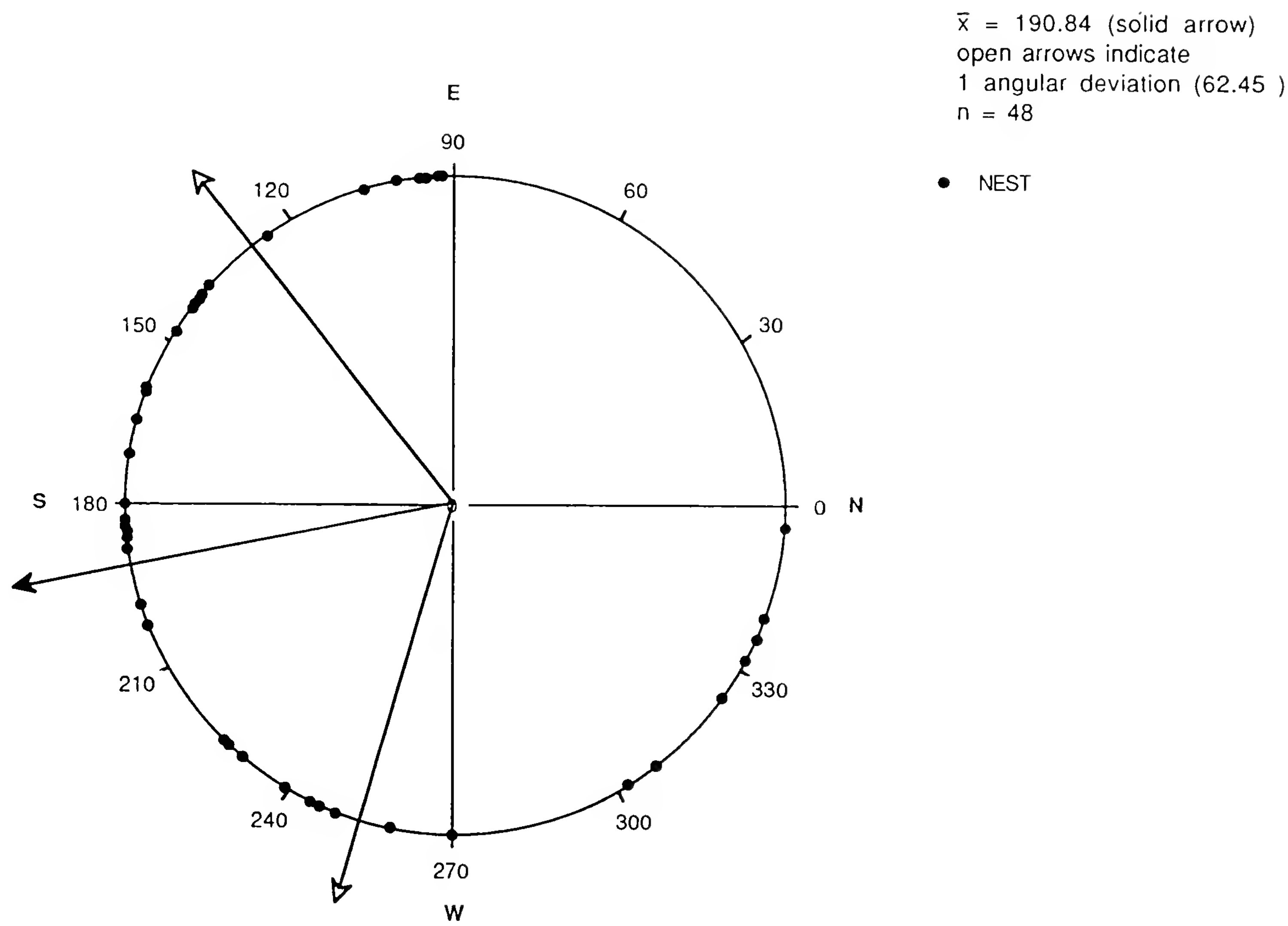

Figure 4. Orientation of Ferruginous Hawk nests in southwest Montana, 1992.

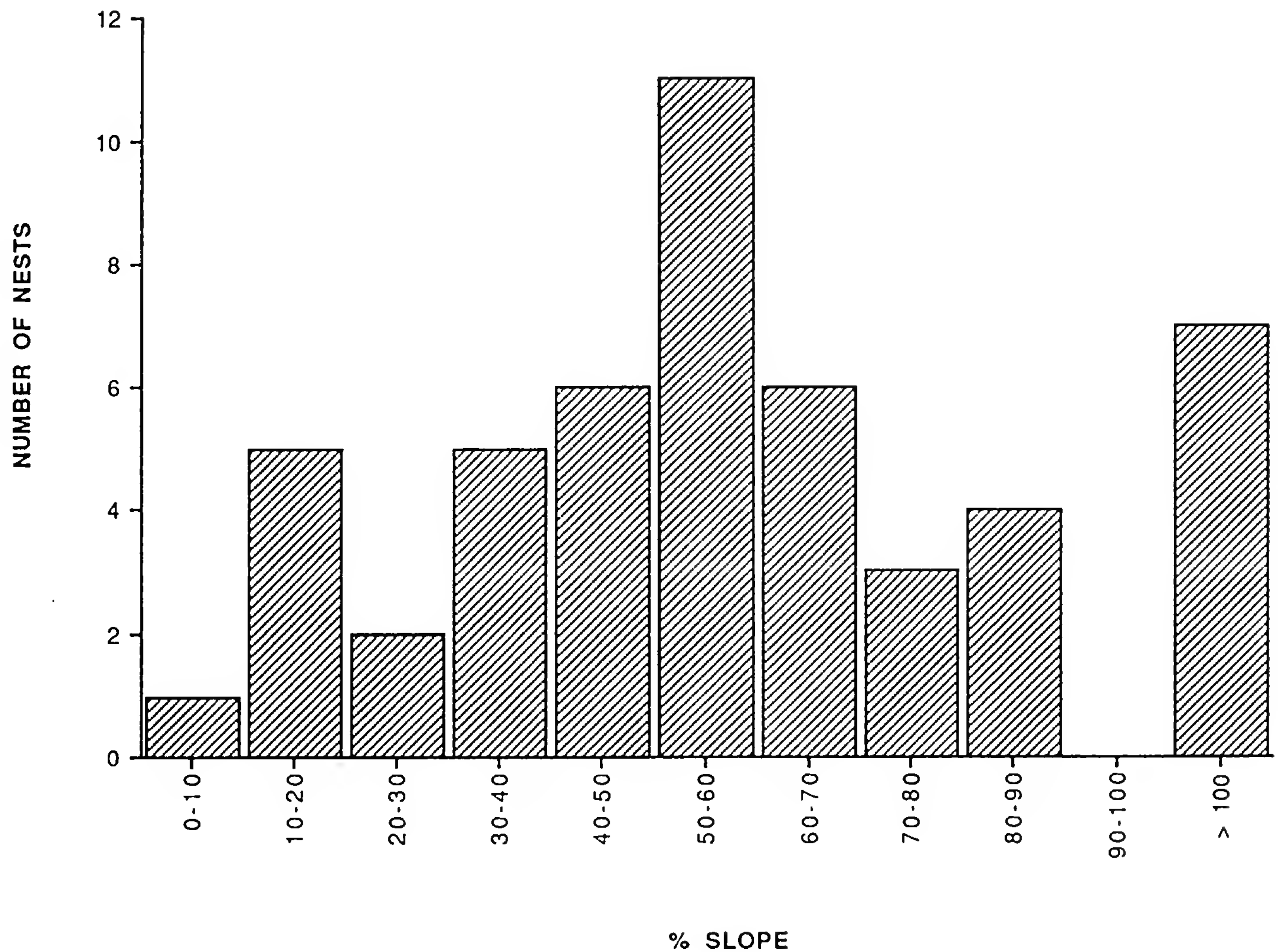

Figure 5. Slopes nested upon by Ferruginous Hawks in southwest Montana, 1992 (n = 50).

placed on the upper 35% of these relatively steep slopes (Figure 6).

Habitat surrounding 43 Ferruginous Hawk nests was largely composed of a mixture of grassland and shrubland. Within 100 m (300 ft) of the nest, the quantity of grassland and shrubland was approximately equivalent, whereas the majority of the area within 1.6 km (1 mile) was composed of grassland (Figure 7). However, most of the nests were found within the Sagebrush (*Artemisia tridentata*) Steppe Association (Kuchler 1964) (Figure 8).

Productivity of Ferruginous Hawks throughout the study area and the Centennial Valley was variable with 81.5% of nests fledging at least one young [$\bar{x}$ = 1.93 fledglings, SD = 1.38 fledglings, n = 27 (all active nests); $\bar{x}$ = 2.36 fledglings, SD = 1.14 fledglings, n = 22 (successful nests)] (Figure 9). The most common number of young fledged per nest was two. Five nests failed to fledge young, apparently due to a number of factors including removal of the nest from a power pole by utility workers (Scott Jackson, U.S. Fish and Wildlife Service, pers. comm.), predation by a corvid, possible shooting of a nestling, chilling of eggs in a nest near a salt lick, and failure to lay eggs by one pair.

Through identification of 87 prey items I determined that Ferruginous Hawks in the southwest Montana study area preyed primarily upon small rodents, especially ground

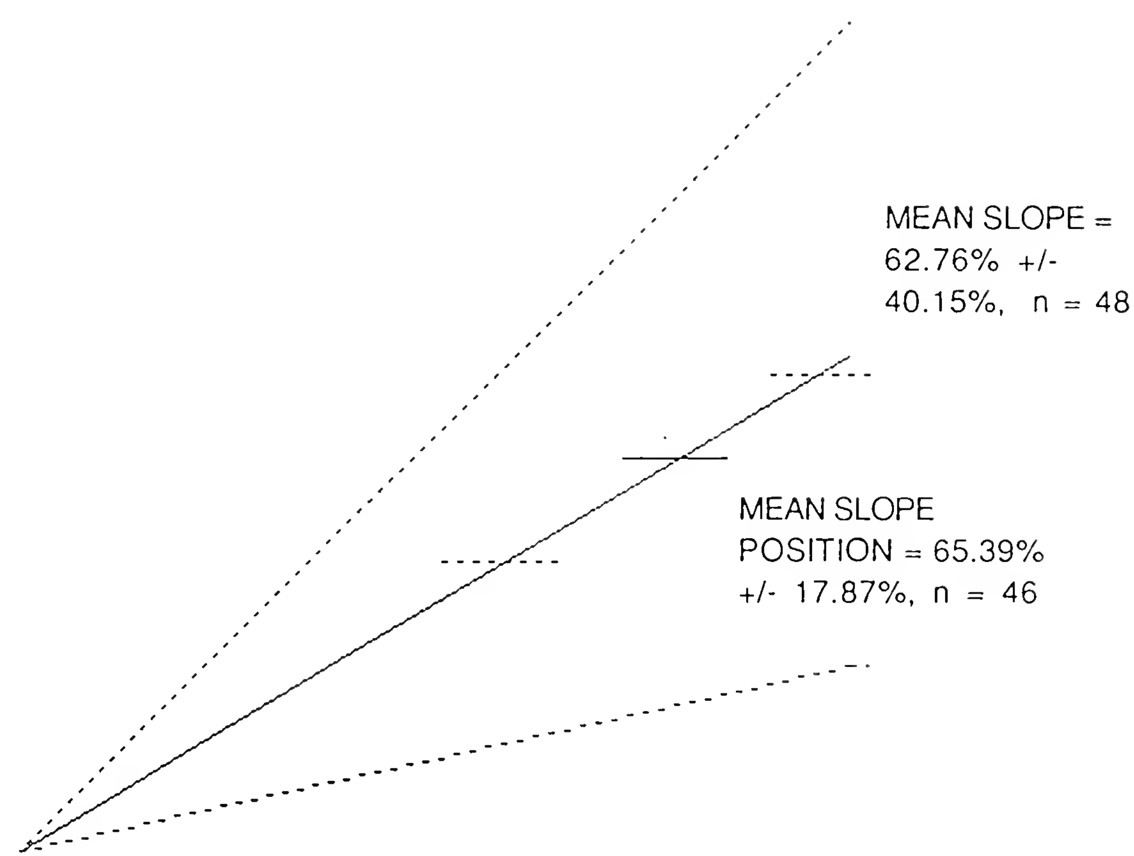

Figure 6. Slope gradient used for nesting and slope position of Ferruginous Hawk nests in southwest Montana, 1992 (n = 50). Solid lines denote means, dashed lines denote one standard deviation.

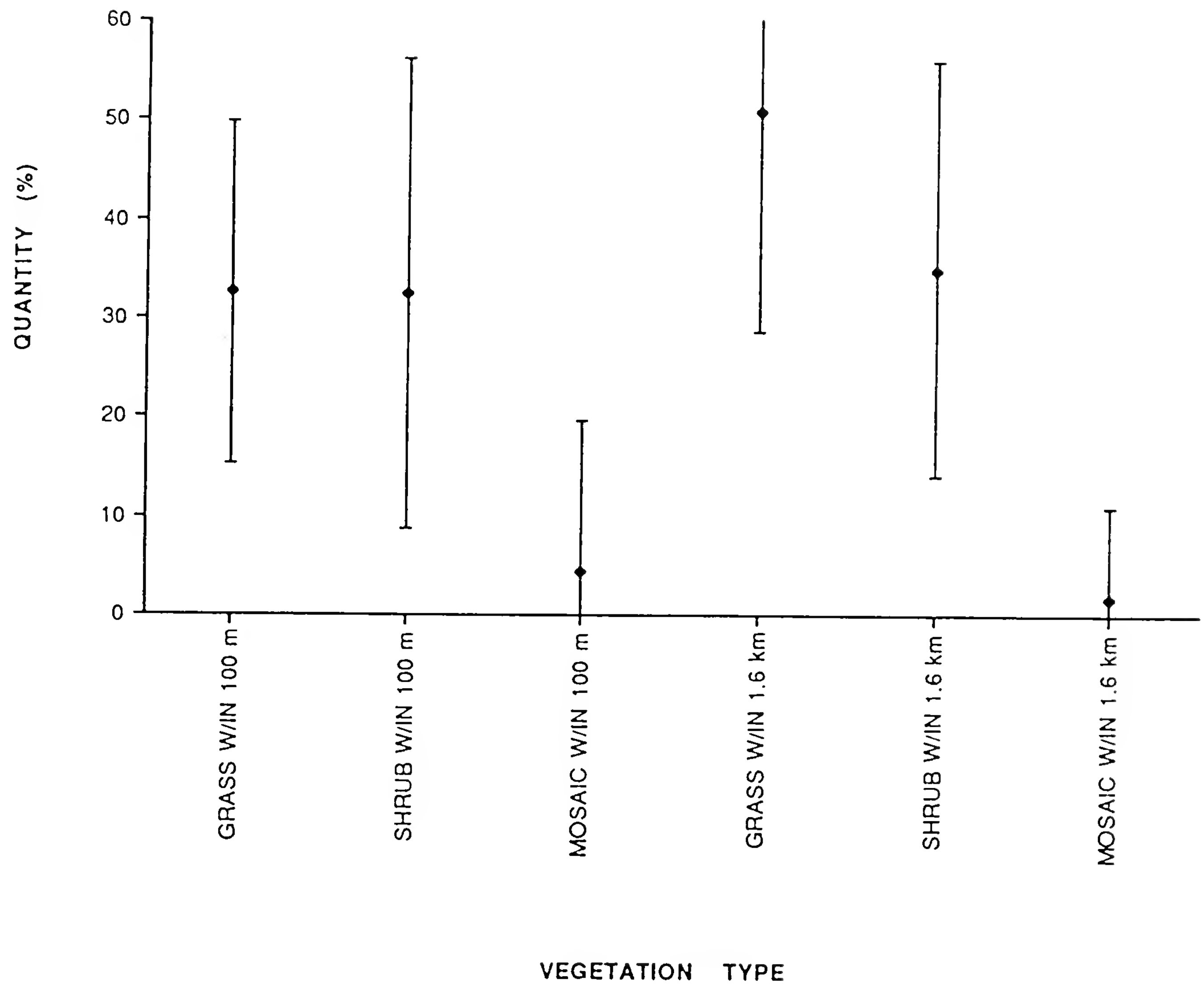

Figure 7. Vegetation surrounding Ferruginous Hawk nests in southwest Montana, 1992 (means with standard deviations, n = 43).

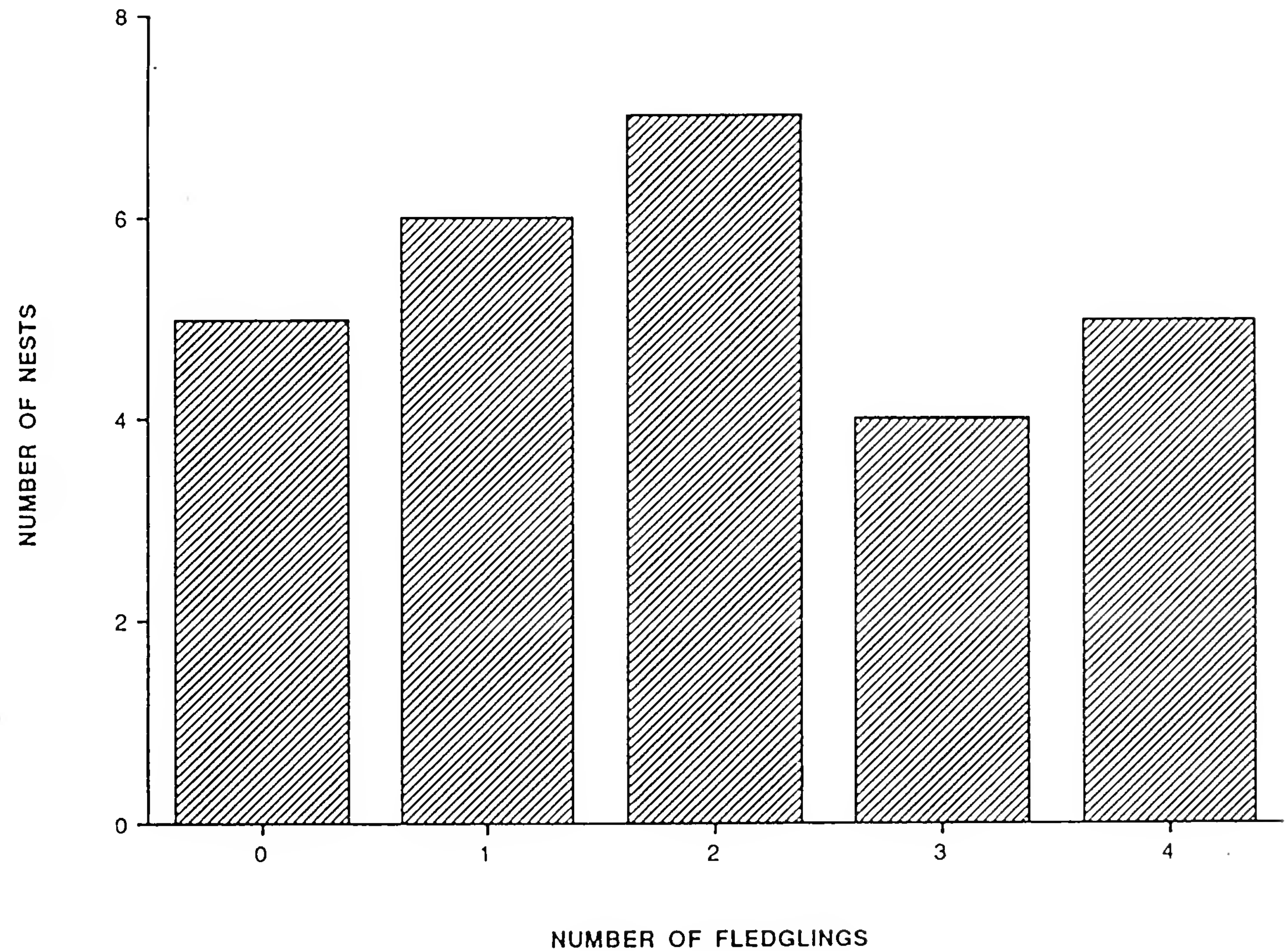

Figure 8. Productivity of Ferruginous Hawks in southwest Montana, 1992 ($\bar{x}$ = 1.93, SD = 1.38, n = 27).

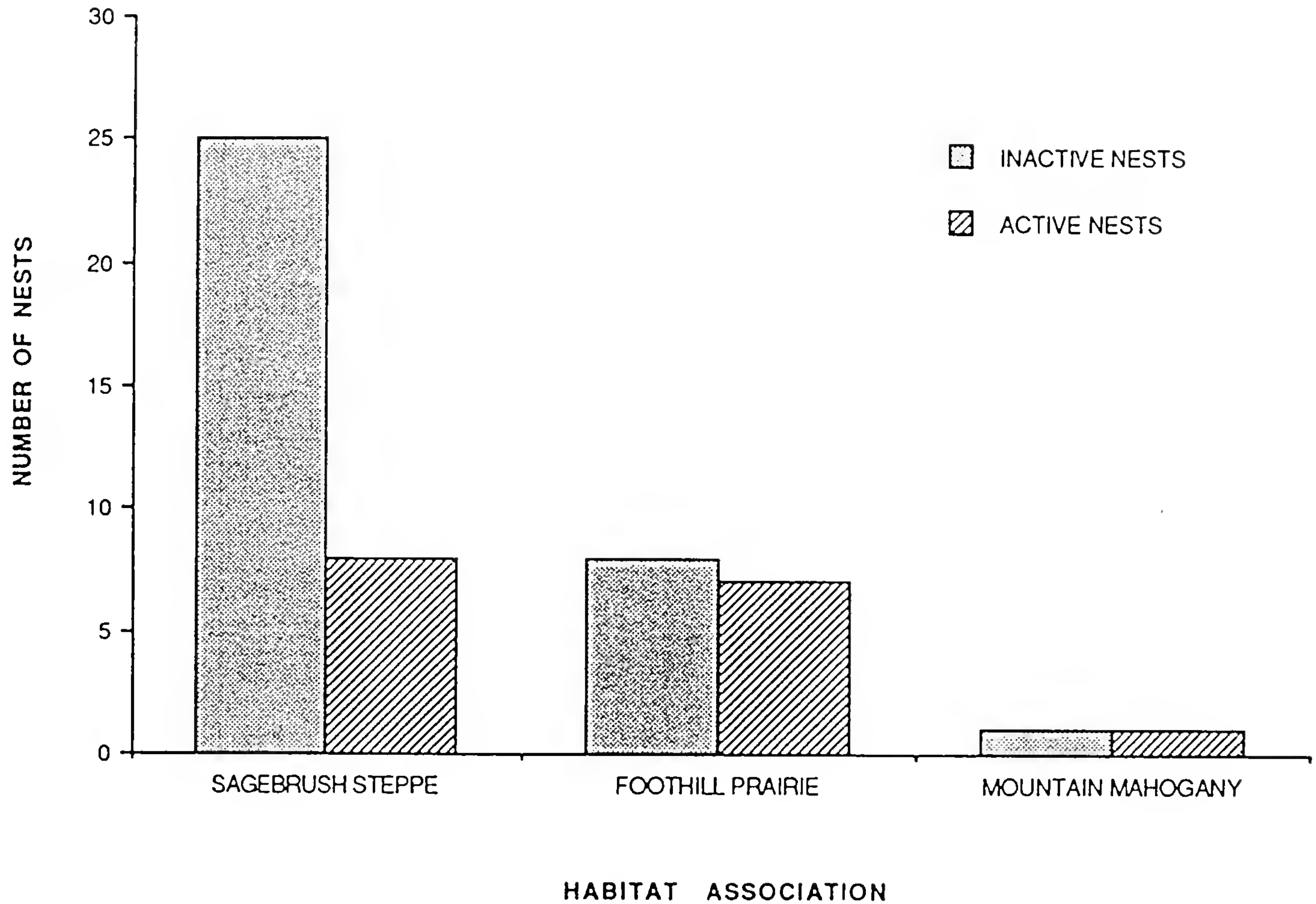

Figure 9. Habitat associations nested within by Ferruginous Hawks in southwest Montana, 1992 (n = 50).

squirrels (*Spermophilus armatus* and/or *S. elegans*) which accounted for nearly 46% of the total number of individual prey items identified (Table 2). In this population of Ferruginous Hawks, birds contributed substantially to nesting season diet accounting for nearly 20% of the identified prey items.

Vegetation diversity in a 375 m^2 plot centered at each of 15 nests from the Centennial Valley to the Frying Pan Basin west of Dillon are presented in Table 3.

DISCUSSION

This study concluded an inventory of the majority of public lands in southwest Montana for nesting Ferruginous Hawks. Even though the surveys were initiated too late to observe hawks early in the nesting season, coupled with the fact that breeding phenology was apparently advanced in 1992 (Jim Roscoe, pers. comm.), I documented a considerable number of successfully breeding Ferruginous Hawks during the study. The proportion of successfully reproducing hawks was high (81.5%) with only 5 nests failing during the breeding attempt. This value is slightly higher than the 57.9 and 70.6% for 1985 and 1986, respectively, reported by Myers (1987) and substantially higher than that reported for southeastern Montana (25-27.3%) (Ensign 1983). However, caution should be exercised when comparing these nesting success data to those of other studies since I may have

Table 2. Prey items identified in pellets and prey remains at Ferruginous Hawk nests.

Taxon	Number	%
Insects		
Red-legged Grasshopper		
Acrididae	12	13.79
Mammals		
Lagomorpha		
Cottontail Rabbit		
Sylvalagus sp.	4	4.60
White-tailed Jackrabbit		
Lepus townsendii	1	1.15
unident. lagomorph	1	1.15
total lagomorphs	(6)	(6.90)
Rodentia		
Northern Pocket Gopher		
Thomomys talpoides	6	6.90
Ground Squirrel		
Spermophilus sp.*	37	45.53
Vole		
Microtus sp.**	4	4.60
Sagebrush Vole		
Lagurus curtatus	1	1.15
Deermouse		
Peromyscus maniculatus	1	1.15
unident. rodent	3	3.45
total rodents	**(49)**	**(56.32)**
total mammals	**(55)**	**(63.22)**
Birds		
Sage Thrasher	7	8.05
Oreoscoptes montanus		
Horned Lark	4	4.60
Eremophila alpestris		
Black-billed Magpie	1	1.15
Pica pica		
Vesper Sparrow	1	1.15
Pooecetes gramineus		
unident. bird	4	4.60
total birds	(17)	(19.54)
Total	87	

Diversity indices:
H' = 2.01
N1 = 7.50
N2 = 4.71

* *S. armatus* or *S. elegans*
** *M. longicaudus* or *M. montanus*

Table 3. Vegetative diversity surrounding Ferruginous Hawk nests as measured through ECODATA methodology (DeVelice 1991).

NEST LOCATION (TRS)	# SPP.	H'	N1	N2	E5
06S09W32NWSWNE	11	1.59	4.89	3.81	0.72
06S09W20SENESW	16	2.39	10.93	10.38	0.94
06S09W17SWSENE	15	2.11	8.23	6.99	0.83
06S09W18SWSESE	11	1.92	6.81	6.01	0.86
06S09W08NESENE	19	2.05	7.79	5.78	0.71
14S04W29NWSWSW	26	2.58	13.26	8.51	0.61
14S04W28NESESE	36	2.56	12.87	8.53	0.63
14S05W35NENENE	18	2.23	9.29	7.50	0.78
14S05W35SWNENW	12	1.89	6.63	4.81	0.68
14S06W33SESENE	12	1.87	6.52	5.61	0.84
15S06W08NESENE	13	2.07	7.93	6.96	0.86
15S06W07SWSWNE	19	2.34	10.34	8.99	0.86
12S07W28SESESE	24	2.27	9.70	6.65	0.65
09S10W19NESWNE	14	1.81	6.13	3.40	0.47
07S11W35SENENW	11	1.96	7.08	6.01	0.82

H' = Shannon Index
N1 = Hill's Number One (number of abundant species)
N2 = Hill's Number Two (number of very abundant species)
E5 = Evenness (Modified Hill's Ratio)

missed nesting attempts that were aborted early in the season. The densities of active Ferruginous Hawk territories were lower than those determined by Myers (1987), however, the study-wide value was still greater than the nesting density found in southeastern Montana (Ensign 1983, Wittenhagen 1991). Myers (1987) observed that the highest nesting density was in the Mountain Mahogany (Cercocarpus ledifolius) Association, whereas the lowest density occurred in the Sagebrush Steppe Association (Kuchler 1964). I surveyed very little of the Mountain Mahogany Association, finding one occupied nest, and the highest densities that I recorded were in the Sagebrush Steppe Association (Diamond Butte Area) and the Foothill Prairie Association (Frying Pan Basin Area). The nesting densities in these latter two areas were comparable to, yet still lower than, the densities reported by Myers (1987) for those two associations. Interestingly, both of the above survey areas contained a considerable portion of private lands; more so than any of the other six areas inventoried.

The number of alternate nests contained within each of the sixteen active territories was very similar to the number/territory described by Myers (1987), with the majority of territories in each study containing no alternate nests.

Productivity per occupied territory was high and similar to the values reported for 1985 and 1986 by Myers (1987). The value of 1.97 fledglings per nest is adequate to maintain a stable population of Ferruginous Hawks based upon minimum requirement of 1.5 fledglings per nest assuming mortality of 66% and 25% for juveniles and adults, respectively (Schmutz and Fyfe 1987, Woffinden and Murphy 1989).

Selection of nesting sites was variable and, hence, quite similar to that described by Myers (1987) for portions of southwest Montana surveyed during 1985 and 1986. While Myers (1987) found that Ferruginous Hawks most commonly nested on the ground, I observed only 3 ground nests, whereas, nests on rocky outcrops were by far the most common nest type accounting for 53% of the nests observed. If only the nests discovered in the actual surveys are included (deleting the nests in the Centennial Valley), only 2 nests were located on the ground and outcrop-nests comprised nearly 66% of the total. Additionally, I determined that average slope upon which Ferruginous Hawks nested was significantly greater than the slope described by Myers (1987) ($\underline{t}$ = 3.232, 0.002 > p <0.001, n = 366). This difference was likely due to the more broken landscape surveyed during this study than during previous surveys in southwest Montana. Additionally, the slope gradient nested upon in southwest Montana was greater than nest slopes in southeast Montana (Ensign 1983). However, like Myers (1987) I determined that the majority of nests were located on the upper portion of slopes which may allow hawks an unobstructed vantage point and an efficient departure route from the nest.

A southern nest exposure such as I observed in this study, as well as in other studies (Smith and Murphy 1982, Ensign 1983, Myers 1987), has been interpreted to indicate a preference for areas of high solar radiation and/or a preference for placing nests in line of the prevailing wind for lofting from the nest (Smith and Murphy 1982, Ensign 1983, Marco Restani, pers. comm.). Solar radiation may be of importance in this high elevation population of Ferruginous Hawks for when birds return from their wintering grounds snow cover may still be present in the study area and periods of inclement weather may occur in the spring (pers. observ.). This importance is borne out by the fact that three of the seven nests with a generally northward exposure (0-90° and 270-360°) were located in trees. Ferruginous Hawks, by nesting in trees, may be able to offset some of the harshness that they would experience when ground nesting on a north-facing slope.

I found the diet of Ferruginous Hawks in southwestern Montana to be quite diverse. Hill's measures of diversity, N1 and N2, correspond to the number of abundant and the number of very abundant species, respectively, in the diet sample (Ludwig and Reynolds 1988). Therefore, over seven ($N1 = 7.5$) different species were classified as abundant, including ground squirrels, red-legged grasshoppers, Sage Thrashers, northern pocket gophers, cottontail rabbits, voles, and Horned Larks. Over four species were classified as very abundant ($N2 = 4.7$). Much of the dietary diversity may be attributed to the fact that Ferruginous Hawks in our study area preyed heavily upon songbirds. Songbirds accounted for nearly 20% of the diet, somewhat higher than the 12.1% reported by Restani (1991) for the Centennial Valley. Other researchers have noted that avian prey usually contribute little to Ferruginous Hawk diet and that a high proportion of avian prey in the diet may be inferred to be the result of hawks preying upon non-preferred and, hence, alternate prey during periods of low prey abundance (Schmutz et al. 1980, Ensign 1983, Gilmer and Stewart 1983). Without actual measures of prey abundance and diversity in southwest Montana, it is difficult to postulate whether avian species are alternate prey to this population of Ferruginous Hawks.

Vegetative diversity within 375 m^2 plots centered at nests, as measured by Hill's N1, was quite variable with five of the six nests exhibiting values > 9.0 located in or adjacent to the Centennial Valley. Additionally, seven of the nine nests with N1 < 9.0 were further north in the Beaverhead Valley. This trend may be due to different precipitation regimes from the Centennial Valley northward (and generally downward in elevation) and apparently was analogous to the prey abundance gradient that I observed.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Ferruginous Hawks are successfully reproducing on the public lands of southwestern Montana. Reproductive success during 1992 was high and hawks chose a variety of substrates upon which to nest. With the addition of the 15 previously unknown active territories discovered during this study to the 97 active territories described by Myers (1987), the five or six active territories on the Blacktail Wildlife Management Area (Dennis Flath, pers. comm.) and the 15 active sites in the Centennial Valley (Restani 1989), I estimate that the breeding population of Ferruginous Hawks in Beaverhead and Madison counties comprise a minimum of 132 pairs. This estimate may be conservative for additional segments of public and private land have yet to be surveyed. These areas include the area between Sweetwater Creek and the Blacktail Wildlife Management Area which contains the Robb Ledford Wildlife Management Area where eight nests have been located [at least two active territories (E. C. Atkinson and Dennis Flath, unpub. data)].

Throughout the study area, active nests appeared to be clumped in their distribution with areas containing decadent nests situated between these active "complexes". Vegetative cover appeared to be similar between the areas of high activity and the unoccupied areas similar to the situation described by Fitzner et al. (1977) in southeastern Washington and Ann Black (pers. comm.) in Phillips County, Montana. I believe that the variables leading to these observations warrant further study. Ultimately, such factors as high site-fidelity, complexes containing related individuals, differential prey populations, grazing practices and the subsequent changes in vegetation associated with different intensities of grazing, in addition to human disturbance may all play a role in determining what areas in southwestern Montana are occupied by breeding Ferruginous Hawks.

The population of Ferruginous Hawks in southwest Montana is one of the most productive groups studied to date. Additionally, these breeding pairs show very high nesting density. Both of these factors lend make southwest

Montana an ideal area for further study, especially long-term projects.

I suggest the following for further work on the Ferruginous Hawk population of southwestern Montana.

A. Management of nest sites.

1. Minimize disturbance. Several researchers have highlighted the vulnerability of Ferruginous Hawks to human disturbance (Olendorff 1973, Ensign 1983), an observation reiterated by the fact that I believe 3 of the 5 recorded nest failures in this study were directly and indirectly human caused. Therefore, I propose direct contact or indirect information for ranchers, seismic crews, prospectors, and others using occupied Ferruginous Hawk habitat during the breeding season. Periods of high susceptibility include, but are not limited to, the period of egg-laying and incubation (mid April to early June) and the period of late nestling stage (early to late July) (Myers 1987, Lewis Myers, pers. comm.). Persons should be advised to maintain a distance of at least 450 m from active hawk nests to avoid flushing the bird (Ensign 1983) and should keep their activities in the territory to a minimum. In areas with active ground nests or easily accessed nests on outcrops, a delay in cattle grazing may allow hawks the opportunity to finish

incubation. Additionally, every effort should be made to place salt licks outside of active Ferruginous Hawk territories and water tanks.

2. Minimize power pole nesting. I observed one renesting attempt by a Ferruginous Hawk pair after their nest had been removed from a power pole. This pair attempted to reuse the same pole which ultimately resulted in loss of the nest during a storm. In areas where hawks attempt to nest on power poles (i.e. the Monida area) deterrents should be erected upon poles to discourage the use of this substrate by Ferruginous Hawks for nesting or suitable alternate structures should be erected nearby.

B. Research.

1. Assess the impacts of grazing. A long term monitoring project on a selected subset of Ferruginous Hawk nests and how the occupancy, nest success, and productivity relate to current and historical grazing practices would be very informative. It has been inferred that grazing can positively influence the foraging of Ferruginous Hawks by removing hiding cover for prey in addition to increasing the densities of some species of small mammals (Kochert et al. 1978, Wakely 1978, Schmutz 1987b). However, over the long term, grazing may also increase the

amount of woody vegetation in an area, a situation that is not conducive to Ferruginous Hawk foraging (Lewis Myers, pers. comm.). Locations on the Dillon Resource Area that may be appropriate for such a project are the Sage Creek area where Ferruginous Hawks are concentrated and the Matador Cattle Company grazes cattle on public land (Jim Roscoe, pers. comm.) and the Frying Pan Basin area.

2. Prey populations should be assessed. I observed what appeared to be a gradient of prey abundance, especially ground squirrels, from the Centennial Valley (high abundance) north to the apparently drier areas west of Dillon (low abundance). Does this apparent gradient correspond with a gradient of Ferruginous Hawk nesting density, nest success, and productivity?

ACKNOWLEDGEMENTS

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Valley and has shared information with the Montana Natural Heritage Program and Jim Reichel (MNHP) reviewed a draft of this report. Sarge Hoem (Montana Dept. of Fish, Wildlife and Parks and Lighthawk, The Environmental Airforce) donated his time to fly our aerial survey. Thanks to the folks at Red Rock Lakes National Wildlife Refuge (USFWS) for providing a bunkhouse for our use. Pam Harrington (MNHP) spent several days identifying the plant communities surrounding nests. Finally, I want to thank the private landowners of southwest Montana who graciously allowed access to and through their land; without their cooperation such a study would suffer greatly.

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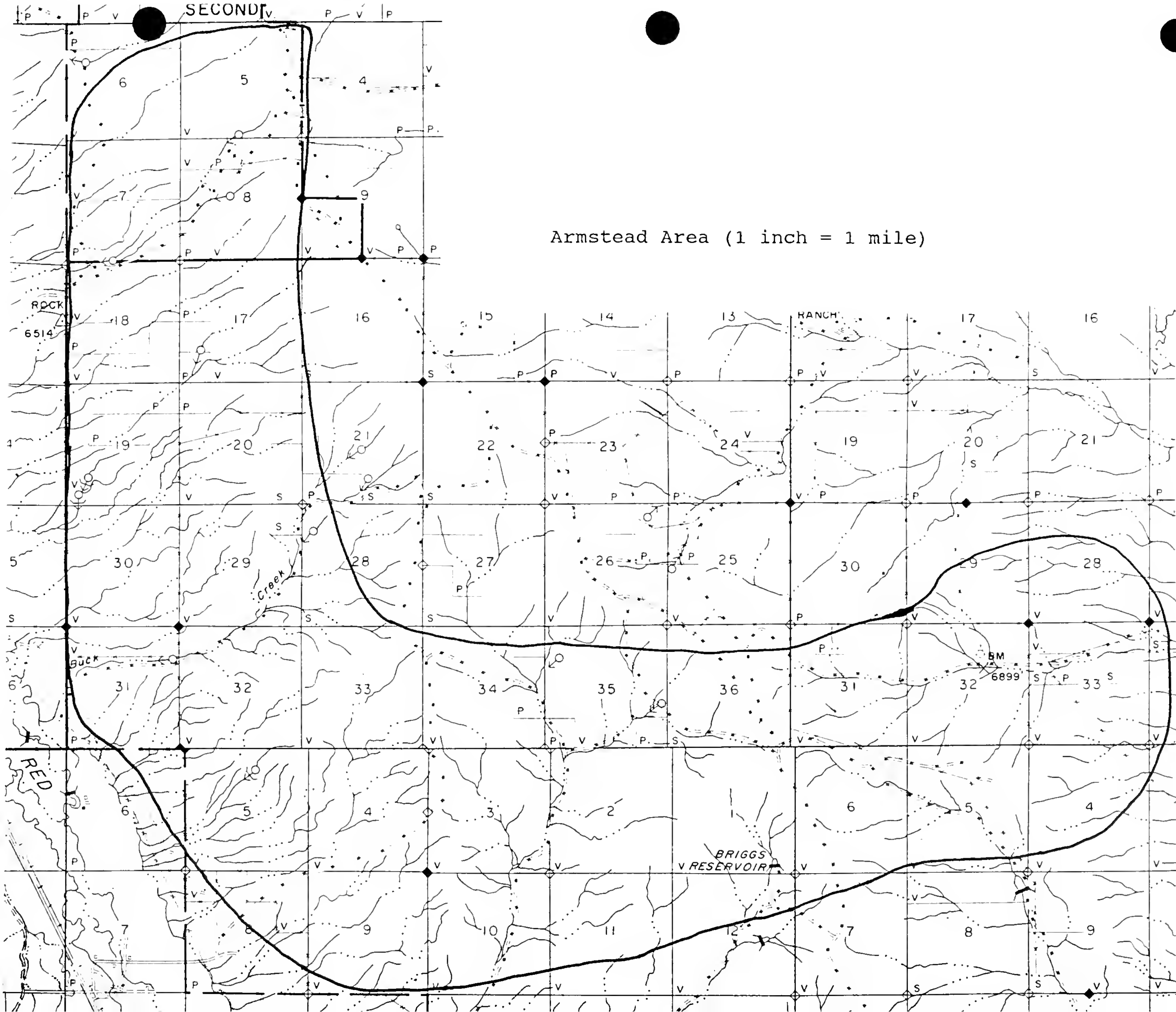
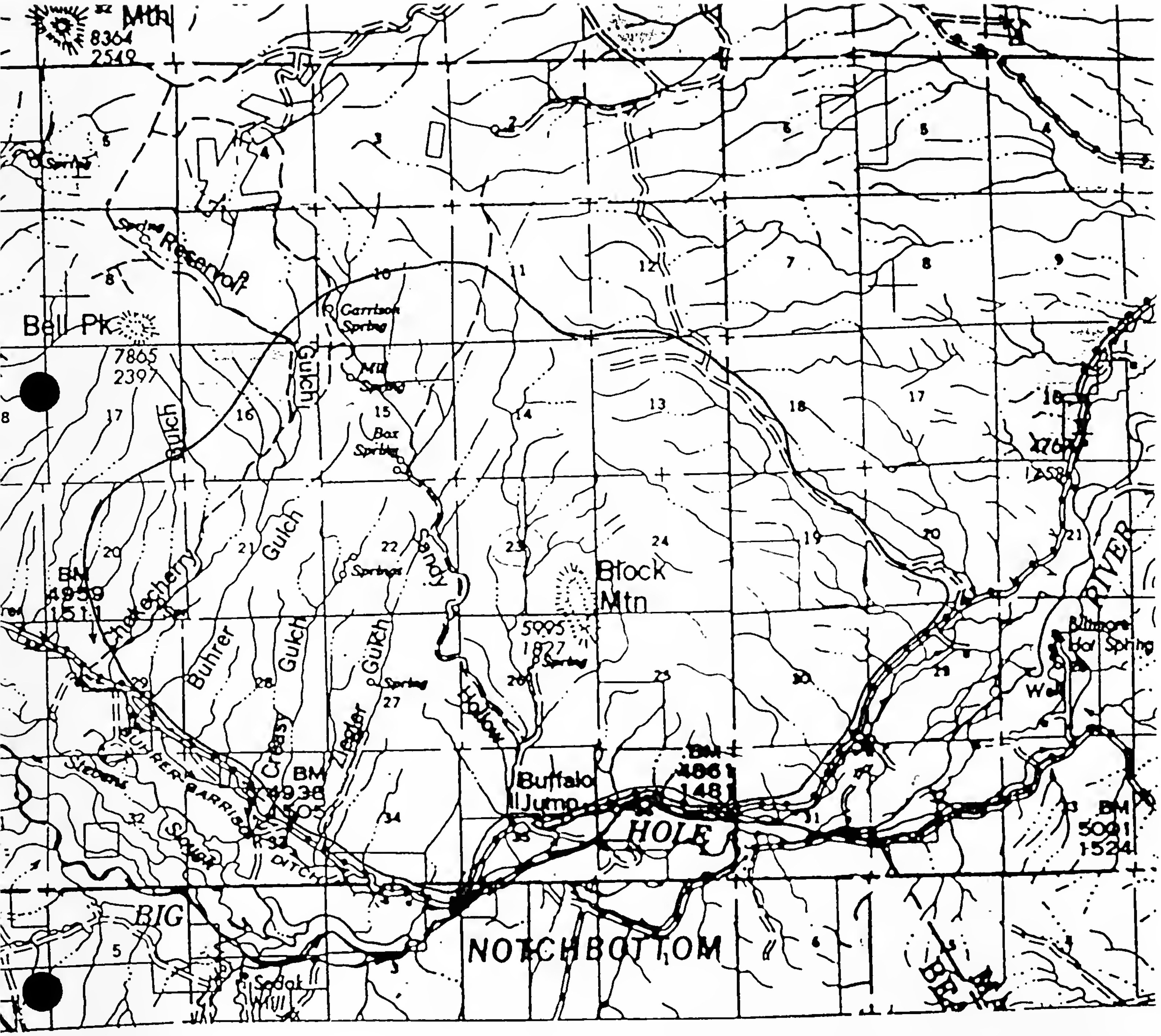
APPENDIX A

Areas surveyed for Ferruginous Hawks on the Dillon Resource Area in southwest Montana (1992).

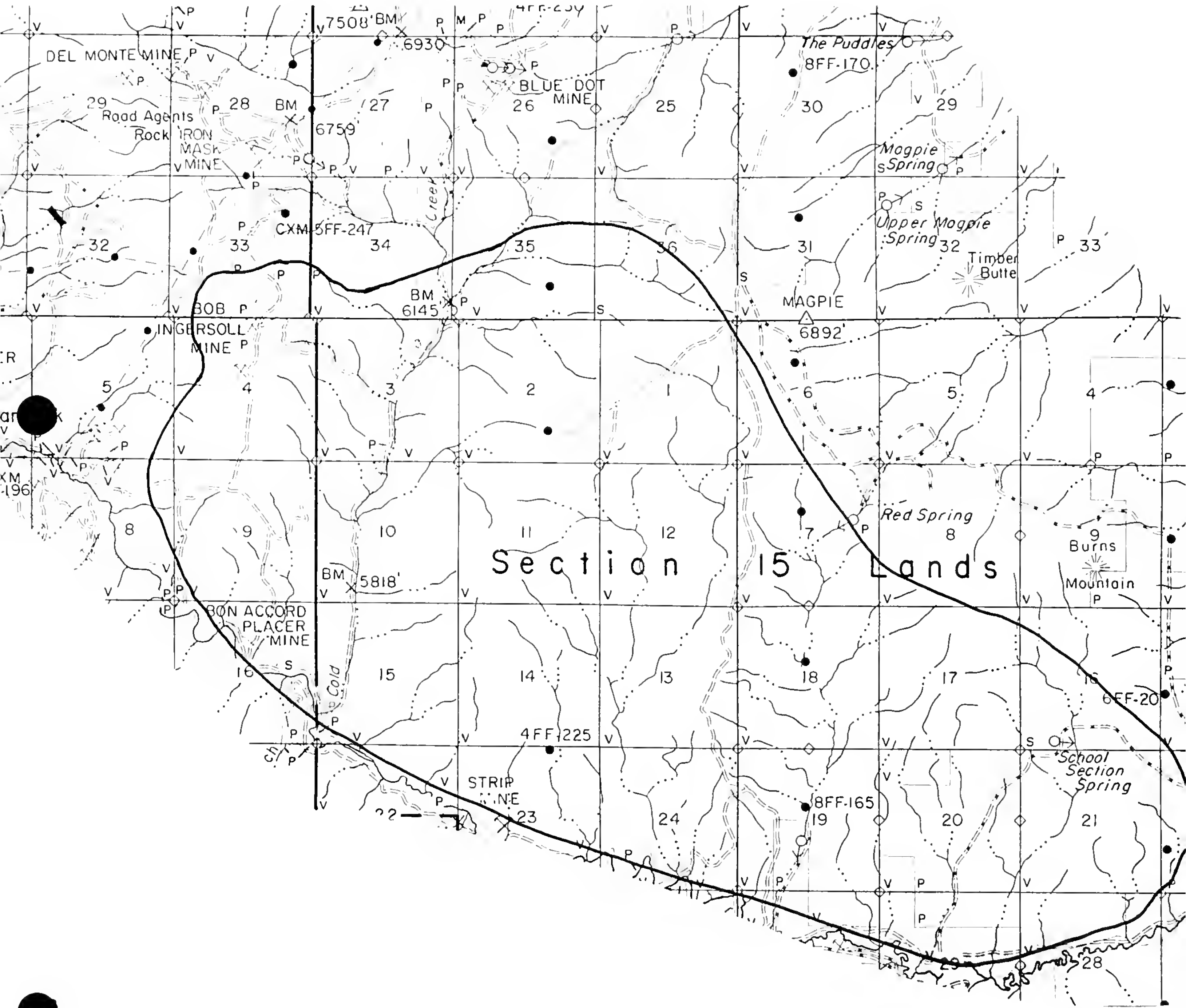
Armstead Area (1 inch = 1 mile)



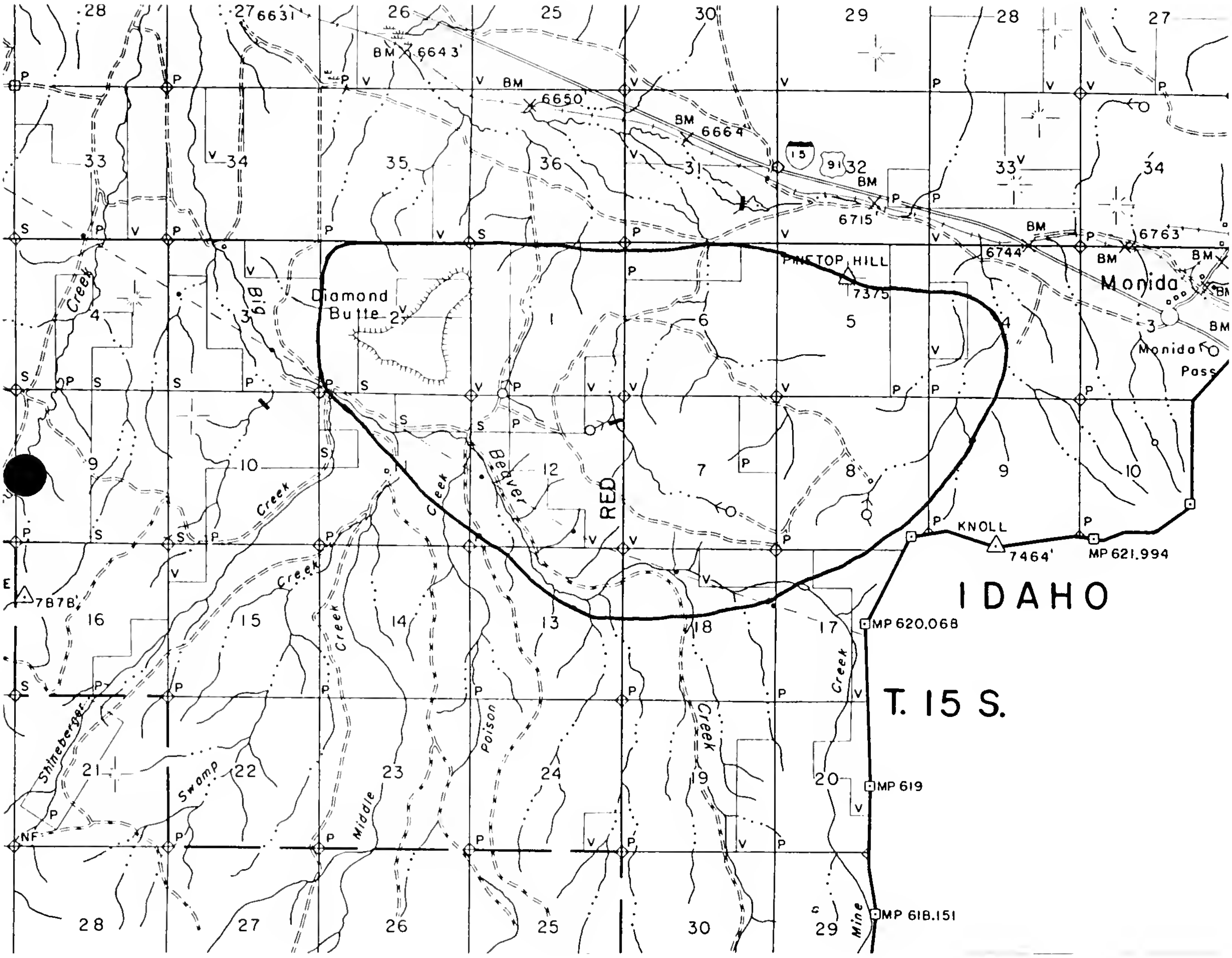
Block Mountain Area (1 inch = 1 mile)



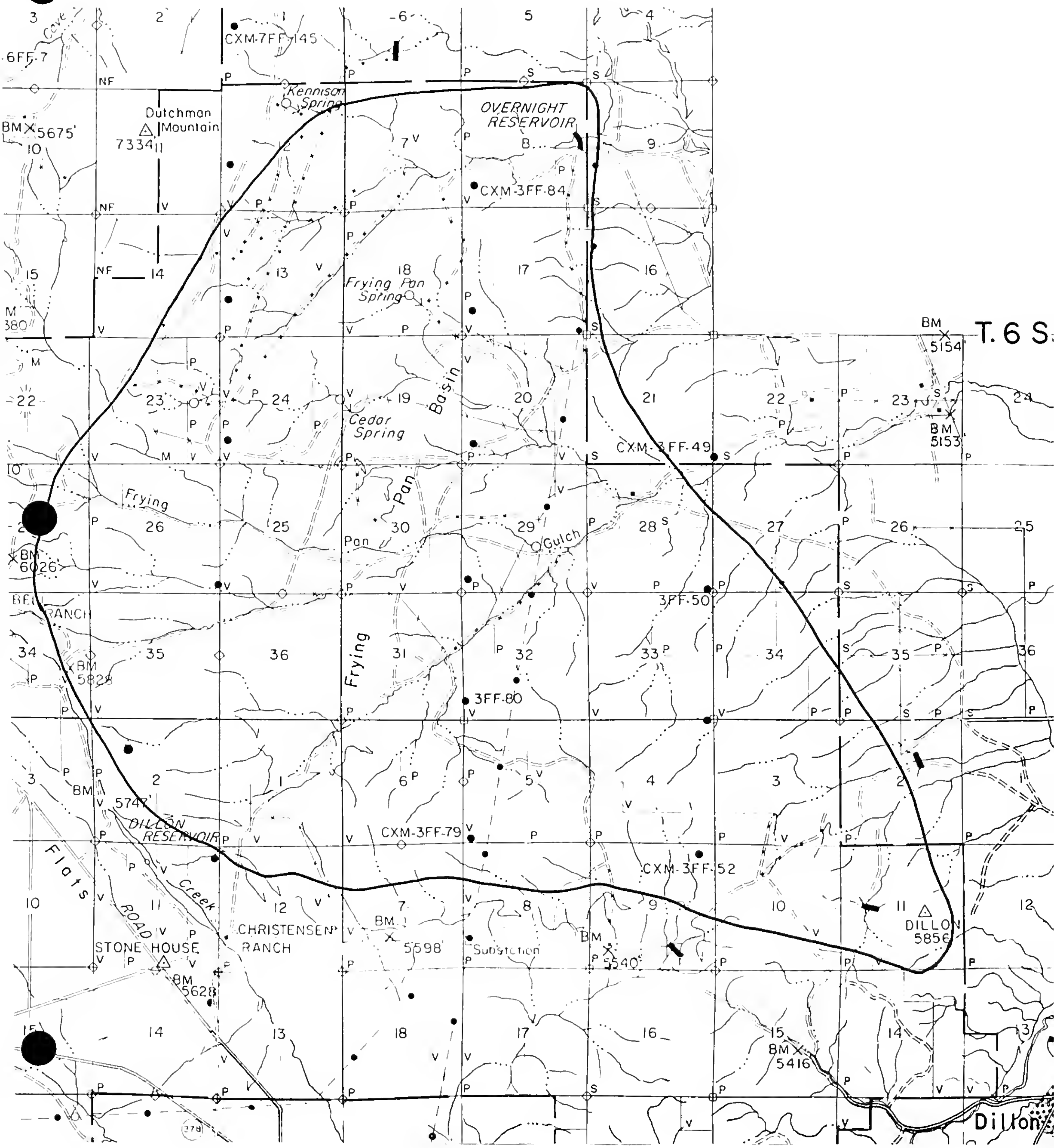
Bannack Area (1 inch = 1 mile) A-02



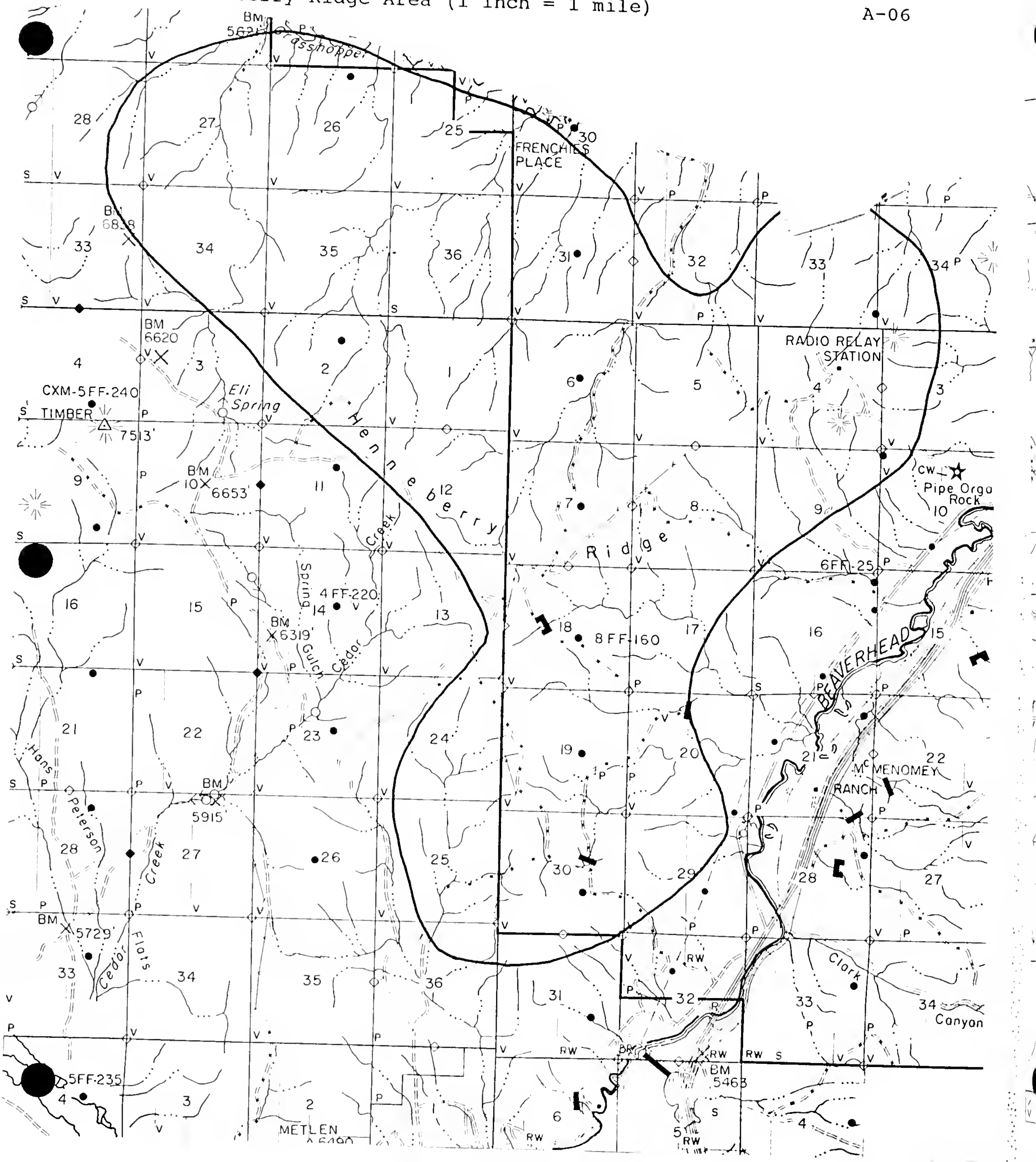
Diamond Butte Area (1 inch = 1 mile)



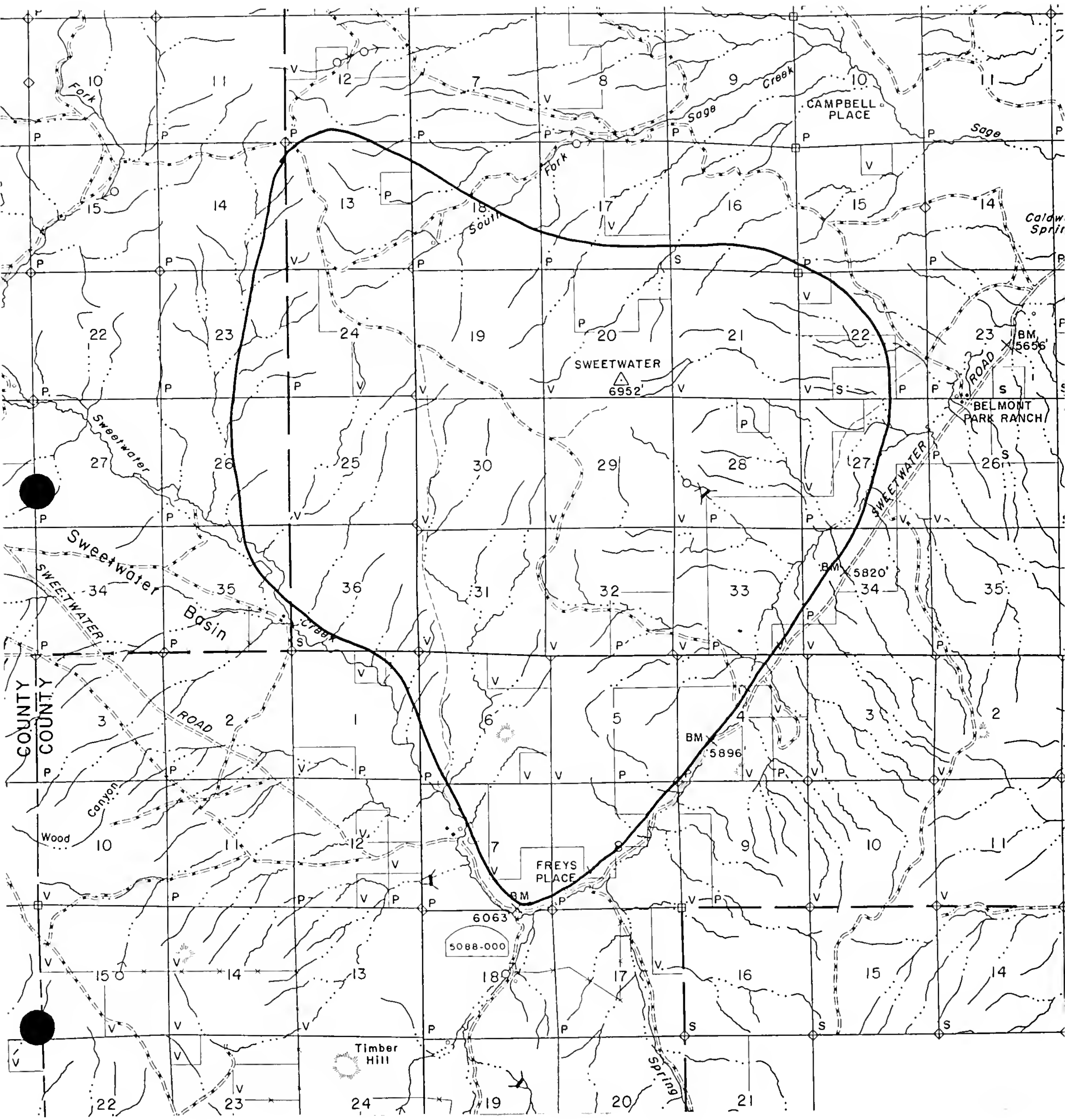
Frying Pan Basin (1 inch = 1 mile)



Henneberry Ridge Area (1 inch = 1 mile)

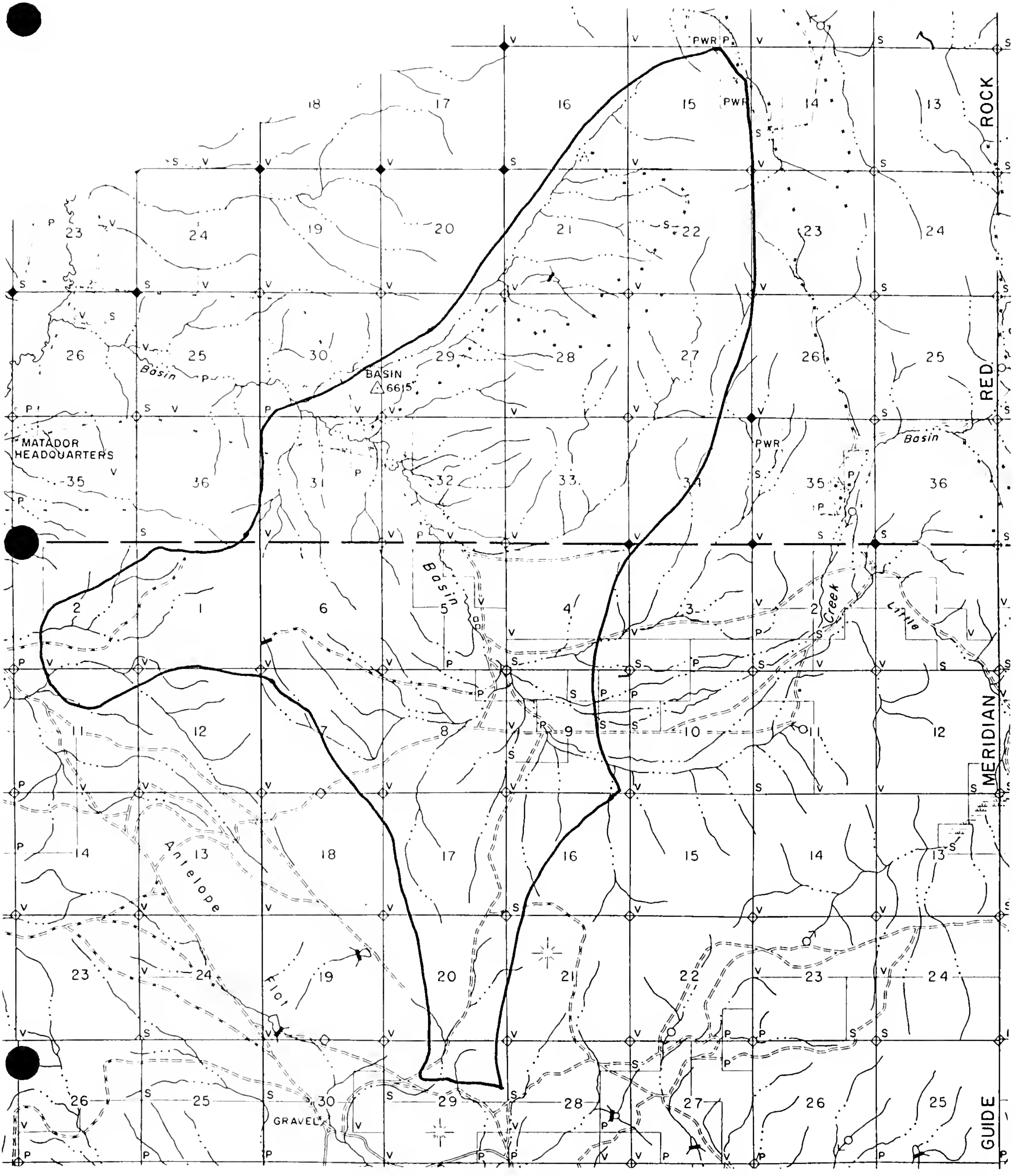


Sweetwater Area (1 inch = 1 mile) A-07



Vinegar Hill Area (1 inch = 1 mile)

A-08



APPENDIX B

Bureau of Land Management "Raptor Nest Inventory" Form.

RAPTOR NEST INVENTORY

(No.)

pecies: ____

ate: ____ Observer: ____

levation: ____ ft. Aspect ____°

ite Slope (%) ____ Land Status ____

Alternate Nest(s)	
T ___ R ___ Sec. ___, ___¼ ___¼ ___¼ - ___	
T ___ R ___ Sec. ___, ___¼ ___¼ ___¼ - ___	A ___ ___
T ___ R ___ Sec. ___, ___¼ ___¼ ___¼ - ___	B ___ ___
T ___ R ___ Sec. ___, ___¼ ___¼ ___¼ - ___	C ___ ___

Location of Alternates from primary nest --- (Dist.) (Bearing)

upport Structure 1/ ____
- Species ____
- Height (ft.) ____
- Position (ft.) ____
- DBH (in.) ____
- Dead Crown (%) ____
- Age (yrs.) ____
- Slope Position (ft.) ____

est Structure
- Platform
  - Height (in.) ____
  - Diameter (in.) ____
  - Material (%) ____

Cliff Structure
- Ledge width (in.) ____
- Overhang (in.) ____
- Lateral extent ____
- Opening dia. (in.) ____
- cliff type 3/ ____
- Sheer extent 4/ ____

est Origin (X)
- Unknown ( )
- Constructed ( )
- Other species ( )

erch Tree
- Distance from nest (ft.) ____
- Species ____
- DBH (in.) ____
- Height (ft.) ____
- Age ____
- Dead Crown (%) ____

Vegetative Structure Type	Radius 300' Height (in.)	Radius 300' Quantity(%)	Radius 300' Canopy (%)	Radius 1 Mile Quantity (%)
Grassland				
Grassland				
Shrub (5-15%)-grass				
Shrub (5-15%)-grass				
Shrubland (> 15%)				
Shrubland (> 15%)				
Shrub-conifer (1-20%)				
Wet Meadow/Riparian				
Riparian woody				
Deciduous woodland				
Conifer (> 20%)				
Conifer (> 20%)				
Scree-rock-talus				
Cropland	N/A			

Edge, distance from (ft.) ____ Eco tonal type 2/ ____

Permanent water, distance from (ft.) ____ Water type ____

Distance from roads (mi.) Primary ____ Secondary ____ Primitive ____

Nearest disturbance (mi.) ____ Describe: ____

Landform ____

Nearest nest (same species): (other species):

NOTES:

B-01

1/ Tree, shrub, ground, outcrop, cliff, pole, dwelling 2/ Only if nest in ecotone

3/ [illegible] single cliff, complex cliff, other

Species ______________________ Nest No. ____________

Date	Adults Occupy Territory (Y,N)	Nest Active (Y,N)	Incubating (Y,N)	Clutch Size	Hatched (Y,N)	No. Nestlings	Fledge Date	Fledge No.	Initials	Notes

APPENDIX C

Completed ECODATA forms and methodology for vegetation surrounding 15 Ferruginous Hawk nests in southwest Montana (1992).

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL — UNITS X ft __m

PLOT NO. F-01 MO 07 DAY 30 YEAR 92 EOCODE — *

EXAMINER(s) Pam Harrington Eric Atkinson

PNC Artemesia tridentata / Agropyron spicatum CT —

SITE Paulicarate Draw STATE MT COUNTY BEAV

PURP G PREC S QUADNAME Bond QUADCODE 4511236

6S T/ 9W R/ 32 S/ NW 4S/ SW 4/4 COMMUNITY SIZE (acres)

PLOT TYPES C PLTRL 35.5' PLOT W — SURVEY AYL

PHOTOS

DIRECTIONS -->

CONSERVATION RANKING

COND ___ Com:
VIAB ___ Com:
DEFN ___ Com:
RANK ___ Com:

MGMT:
PROT:

ENVIRONMENTAL FEATURES

DL Shrub SOIL RPT —

SOIL UNIT — SOIL TAXON —

PM — LANDFORM PLOT POS — SLP SHAPE — ASP

SLOPE % ELEVATION EROS POTENT — EROS TYPE —

HORIZON ANGLE (%): N ___ E ___ S ___ W ___ IFSLP — IFVAL —

SPFE —

GROUND COVER: 10 S+ 1 G+ 30 R+ 20 L+ 20 W+ 20 M+ 10 BV+ 10 O = 100% lichen

DISTURBANCE HISTORY (type, intensity, frequency, season)-->

RIPARIAN FEATURES: Channel Width — Channel Entrench —
Surface Water — Ht.Abv.H20 — Dist. from H20 —

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

OCULAR PLANT SPECIES DATA

C-02

PltIDL —

PLOT NO. F-01 NO. SPECIES 11 PNC ARTTRI / AGRSPI

TREES Tot Cv — MHt ___
Tal Cv ___ Med Cv ___
Low Cv ___ Grd Cv ___

		CC
T 1	/	
T 2	/	
T 3	/	
T 4	/	
T 5	/	

SHRBS Tot Cv 70 MHt 1.5'
Tal Cv – Med Cv 10
Low Cv 10 Grd Cv 3

		CC
S 1	Artemisia tridentata / ART TRI	60
S 2	Artemisia rigida / ARTRIG	3
S 3	Gutierrezia sarothrae / GUT SAR	1
S 4	Opuntia polyacantha / OPU POL	3
S 5	'Ribes' spp / RIB	1
S 6	Chrysothamnus nauseosus / CHR NAU	1
S 7	/	
S 8	/	
S 9	/	
S10	/	
S11	/	
S12	/	

GRAM Tot Cv 50 MHt 1'
Med Cv 1 Low Cv 50
Grd Cv 10

		CC
G 1	Poa sandbergii / POA SAN	20
G 2	Agropyron spicatum / AGR SPI	20
G 3	Sitanion hystrix / SIT HYS	20
G 4	/	
G 5	/	
G 6	/	
G 7	/	
G 8	/	
G 9	/	
G10	/	
G11	/	
G12	/	

FRBS Tot Cv T MHt .25'
Med Cv — Low Cv T
Grd Cv T

		CC
F 1	Astragalus drummondii / AST DRU	T
F 2	Eriogonum microthecum / ERI MIC	T
F 3	/	
F 4	/	
F 5	/	
F 6	/	
F 7	/	
F 8	/	
F 9	/	
F10	/	
F11	/	
F12	/	
F13	/	
F14	/	
F15	/	

FERN Tot Cv — MHt ___ Med Cv ___
Low Cv ___ Grd Cv ___

BRYO/LICH Tot Cv 20 / 10
Sel

COMMENTS (EODATA) --> ___

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL — UNITS X ft __ m

PLOT NO. F-02 MO 07 DAY 30 YEAR 92 EOCODE — *

EXAMINER(s) Pam Harrington Eric Atkinson

PNC Rhus trilobata / Agropyron spicatum CT —

SITE Transmission Line Nort STATE MT COUNTY BEAV

PURP G PREC S QUADNAME BOND QUADCODE 4511236

6S T/ 9W R/ 20S/ SE 4S/ NE4/4 COMMUNITY SIZE (acres)

PLOT TYPES C PLTRL 35.8 PLOT W — SURVEY AYL

PHOTOS

DIRECTIONS -->

CONSERVATION RANKING

COND ___ Com:

VIAB ___ Com:

DEFN ___ Com:

RANK ___ Com:

MGMT:

PROT:

ENVIRONMENTAL FEATURES

DL Shrub SOIL RPT —

SOIL UNIT — SOIL TAXON —

PM — LANDFORM ___ PLOT POS — SLP SHAPE — ASP ___

SLOPE % ___ ELEVATION ___ EROS POTENT — EROS TYPE —

HORIZON ANGLE (%): N ___ E ___ S ___ W ___ IFSLP — IFVAL —

SPFE —

GROUND COVER: 20 S+ 40 G+ 20 R+ 10 L+ — W+ — M+ 10 BV+ — O = 100%

DISTURBANCE HISTORY (type, intensity, frequency, season)-->

RIPARIAN FEATURES: Channel Width — Channel Entrench —

Surface Water — Ht.Abv.H20 — Dist. from H20 —

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

OCULAR PLANT SPECIES DATA

C-04
PltIDL —

PLOT NO. [illegible] NO. SPECIES 16 PNC RHUTRI / AGRSPI

TREES Tot Cv — MHt ___
Tal Cv ___ Med Cv ___
Low Cv ___ Grd Cv ___

		CC
T 1	/	
T 2	/	
T 3	/	
T 4	/	
T 5	/	

SHRBS Tot Cv 50 MHt .75'
Tal Cv — Med Cv 20
Low Cv 10 Grd Cv 20

		CC
S 1	Chrysothamnus nauseosus / CHRNAU	20
S 2	Artemisia frigida / ARTFRI	20
S 3	Gutierrezia sarothrae / GUTSAR	10
S 4	Opuntia polyacantha / OPUPOL	20
S 5	Eriogonum microthecum / ERIMIC	1
S 6	Artemisia tridentata / ARTTRI	10
S 7	/	
S 8	/	
S 9	/	
S10	/	
S11	/	
S12	/	

GRAM Tot Cv 20 MHt 1'
Med Cv — Low Cv 20
Grd Cv 20

		CC
G 1	Bouteloua gracilis / BOUGRA	20
G 2	Carex filifolia / CAREFI	5
G 3	Poa sandbergii / POASAN	10	-1
G 4	Bromus tectorum / BROTEC	1
G 5	Agropyron spicatum / AGRSPI	20	F-1
G 6	/	
G 7	/	
G 8	/	
G 9	/	
G10	/	
G11	/	
G12	/	

FRBS Tot Cv 20 MHt .2'
Med Cv — Low Cv —
Grd Cv 20

		CC	
F 1	Astragalus drummondii / ASTDRU	1	F-1
F 2	Astragalus spp /	10	x
F 3	Phlox hoodii / PHLHOO	20	
F 4	Sphaeralcea coccinea / SPHCOC	1	
F 5	Antennaria parvifolia / ANTPAR	1	
F 6	/		
F 7	/		
F 8	/		
F 9	/		
F10	/		
F11	/		
F12	/		
F13	/		
F14	/		
F15	/		

FERN Tot Cv — MHt ___ Med Cv ___
Low Cv ___ Grd Cv ___
BRYO/(LICH) Tot Cv — / T

COMMENTS (EODATA) --> ___