RRR184

PREY BASE ANALYSIS BY HABITAT SITE, TAOS RESOURCE AREA NEAR QUESTA IN TAOS COUNTY, NEW MEXICO (PEREGRINE FALCON PREY)

A STUDY PERFORMED FOR THE
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1.0 INTRODUCTION

The American Peregrine Falcon (Falco peregrinus anatum) is an endangered species, protected by the Endangered Species Act of 1973. As such, care must be taken to protect suitable nesting habitat and adjacent hunting areas. The Guadalupe Mountain Study Area could be a hunting area for nesting Peregrine Falcons, since nearby areas fit the definition of Suitable Nesting Habitat (Rocky Mountain/Southwest Peregrine Falcon Recovery Team 1984; USDA Forest Service et al. 1985).

This study was initiated to gather information on the availability and quality of the avian prey base breeding in or migrating through the 18,770 acre Guadalupe Mountain Study Area in northern New Mexico. This area includes active and proposed future mill tailings sites (USDI/BLM 1983). The majority of the area (> 95%) is managed by the U. S. Bureau of Land Management (BLM) and the information generated from this study will be used by the BLM to make land use decisions, develop environmental assessments and/or impact studies, and aid in compliance with Section 7 requirements of the Endangered Species Act of 1973. This information will also allow the BLM to manage for preferred avian habitat sites in northern New Mexico, recommend mitigating measures for management of active tailings reservoirs, and aid the reclamation of defunct tailings facilities near Questa, New Mexico.

The primary objectives of this study are:

- to identify the habitat sites within the study area, using vegetative and land form characteristics as the bases for identification;
- to map the habitat sites within the study area and provide a detailed narrative description of each habitat site;
- to determine populations of potential avian prey of Peregrine Falcons by habitat site during the nesting season; and
- to determine organochlorine contamination levels of representative and /or probable Peregrine Falcon prey.

The study area description and habitat site narratives are presented in Section 2.0 and the habitat map is in Appendix A. The avian communities nesting on the study area are discussed in Section 3.0, and the quality of potential Peregrine Falcon prey species based on organo-chlorine analysis of representative samples is presented in Section 4.0. Management recommendations and the literature cited within the report follow in Sections 5.0 and 6.0, respectively. Avian census grid maps are in Appendix B, photographs documenting grid corners are in Appendix C, and avian species incidentally observed in the study area are in Appendix D.

2.0 HABITAT SITES

Study Area

The study area is located in east central Taos County, New Mexico and includes the BLM managed Rio Grande Wild and Scenic River Area and Guadalupe Mountain. Twelve hundred acres of existing mill tailings sites and agricultural fields owned by Molycorp, Inc., which are located 1 1/2 miles east of Guadalupe Mountain, are also included in the study area. No mill tailings sites currently exist on the BLM property but the property is currently being evaluated as a future mill tailings site (USDI/BLM, 1983).

The Guadalupe Mountain Study Area (hereafter GMSA) is bordered by the Rio Grande Gorge on the west, the Red River Canyon on the south, BLM and Molycorp property lines west of Questa, New Mexico on the east and N. M. Highway 378 on the north (Appendix A). The BLM portion of the study area is characterized by an elongated northwest-southeast trenching, nearly flat-lying valley, flanked on the northeast and southeast by moderately steep (up to 30% gradient), fairly well dissected mountain slopes (USDI/BLM 1983). The valley slopes gently (< 5%) from a high point near its center towards both ends, where it abruptly narrows to steep-sided arroyos that drain towards the Rio Grande and the Red River (USDI/BLM, 1983). Local relief on the site is about 2200 ft, with elevations varying from a low of 6600 ft at the confluence of the Red and Rio Grande rivers to 8763 ft at the top of the northeast peak of Guadalupe Mountain.

The Molycorp, Inc. property is in a gently sloping agricultural valley southeast of Guadalupe Mountain. The valley slopes (< 1% grade) to the southwest where it drains into the Red River. Local relief is 200 ft, with elevations ranging from about 7400 to 7600 ft (USDA/SCS 1981).

The study area is located in the High Intermountain Plateau Subresource Area (USDA/SCS, 1978; 1982a). This area of north central New Mexico is characterized by nearly level to gently sloping old valley fill with gently sloping to steep hills and canyons, underlain by basalt. Annual precipitation

is 10-14 in., and the average annual temperature is 45° F. with a range of -30° to 100° F. The frost free season ranges from 90-130 days. Soils and associated climatic factors support vegetative communities similiar to that of the Great Basin Desert Shrub Formation (see Habitat Site descriptions for more details) (USDA/SCS, 1982a). The potential natural vegetation for this area includes the big sagebrush, western wheatgrass/big sagebrush and pinyon-juniper/big sagebrush associations at lower elevations and the Ponderosa pine-Douglas fir association at the upper elevations (USDA/SCS, 1978).

Habitat Sites

Methods

Initial delineation of habitat sites on the study area was made by analyzing aerial photographs and then preparing a preliminary habitat site map. Eight habitat sites were initially delineated: sagebrush/grassland, pinyon-juniper woodland, agricultural lands, wooded canyon benches, canyon slopes, riparian, mixed conifer, and pinyon-juniper/mixed conifer. Mill tailings were also mapped separately but were not considered a habitat site for breeding birds because of the paucity of vegetation on them. Efforts were concentrated on agricultural lands on Molycorp's property, since this plant community would best represent the vegetation of the reclaimed tailings.

These preliminary habitat sites were tested and refined through field studies conducted in September 1984. Two step-point transects (Evans and Love, 1957) were conducted across each habitat site on paths selected to ensure thorough coverage of the habitat site diversity while permitting reliable characterization of the habitat site. One transect per habitat site was located in the area of the spot-mapping grid on that site (see Section 3.0). The transect locations are indicated on the map in Appendix A.

Each transect consisted of approximately 200 recording points. Total percent ground cover was estimated ocularly at every twentieth point, and shrub and tree characterization plots were sampled every sixtieth point. The

following data were collected in the 1/100th acre shrub and tree characterization plots:

- total number of trees and shrubs by species within the plot; and
- form, average phenology, age class and height of a minimum of five individuals within each plot.

Results

Based on the step-point transect data, detailed aerial photo analyses, a review of the relevant literature, and general field observations the mixed conifer and pinyon-juniper/mixed conifer initial habitat sites were combined into one habitat site, upland forest. The remaining six habitat sites delineated initially remained unchanged. Descriptions of the seven habitat sites are presented below. A list of the plant species found on the study area during the September 1984 field investigations are listed in Table 2-1. Common and scientific names used in the following narratives are from Martin and Hutchins (1980). Acronyms are based on the USDA/Forest Service (1978) system.

Sagebrush/Grassland Habitat Site

The Sagebrush/Grassland Habitat Site is characterized by a paucity of trees and the appearance of widespread uniformity in the composition and growth habits of the plant community. Only 11 plant species were noted on the two transects conducted through this habitat site (Table 2-2). Of these, three species, crested wheatgrass (Agropyron cristatum), blue grama (Bouteloua gracilis), and big sagebrush (Artemisia tridentata) accounted for an average of 94% of all vegetative hits on the two transects. Ninety-five percent of the individuals in the shrub and tree plots were big sagebrush (Table 2-3) and the majority of individuals were mature, in the vegetative stage, and 1-2 ft in height.

The Sagebrush/Grassland Habitat Site is found throughout north central New Mexico (USDA/SCS, 1978; Martin and Cramer 1980). While soil types and plant species composition exhibit some variation within this habitat site, it

Table 2-1. Plant list for the Guadulupe Mountain Study Area, Taos County, New Mexico.

Scientific Name	Common Name	Symbol
Alnus tenuifolia Nutt.	thinleaf alder	Alte
Agropyron cristatum (L.) Gaertn.	crested wheatgrass	Agcr
Agropyron smithii Rydb.	western wheatgrass	Agsm
Agropyron trachycaulum (Link) Malte	slender wheatgrass	Agtr 1
Agropyron sp.	wheatgrass	AGRO
Andropogon scoparius Michx.	little bluestem	Ansc
Androsace septentrionalis var. subulifera Gray	rockjasmine	Anse
Apocynum sp.	indian-hemp	APOC
Arctium minus (Hill) Bernb.	burdock	Armi
Aristida fendleriana Steud.	Fendler three-awn	Arfe 1
Aristida purpurea Nutt. var. purpurea	purple three-awn	Arpu 1
Artemisia campestris subsp. pacifica (Nutt.) Heller	sagebrush	Arca
Artemisia dracunculus L.	false tarragon	Ardr 2
Artemisia frigida Willd.	fringed sage	Arfr
Artemisia cf. ludoviciana	Louisiana wormwood	Arlu
Artemisia tridentata Nutt.	big sagebrush	Artr
Astragalus sp.	milkvetch	ASTR
Atriplex canescens (Pursh) Nutt.	fourwing saltbush	Atca
Beckmannia syzigachne (Steud.) Fernald	American sloughgrass	Besy
Bouteloua curtipendula (Michx.) Torr.	sideoats grama	Bocu
Bouteloua eriopoda (Torr.) Torr.	black grama	Boer
Bouteloua gracilis (H.B.K.) Lag.	blue grama	Bogr
Bromus ciliatus L.	hairy brome	Brci
Bromus cf. inermis	smooth brome	Brin 1
Bromus tectorum L.	cheatgrass	Brte
Bromus sp.	brome-chess	BROM
Carex nebrascensis Dewey	Nebraska sedge	Cane
Carex sp.	sedge	CARE
Cercocarpus montanus Raf.	mountain mahogany	Cemo
Chenopodium fremontii Wats.	goosefoot	Chfr
Chrysothamnus nauseosus subs. bigloviii (Gray) H.&C.	rubber rabbitbrush	Chna
Chrysothamnus parry (Gray) Greene subs. attenuatus (M. E. Jones) H.&C.	rabbitbrush	Chpa
Chrysothamnus vaseyi (Gray) Greene	rabbitbrush	Chva
Cicuta douglassii (DC.) Coult. & Rose	western water hemlock	Cido
Clematis ligusticifolia Nutt.	virgin's bower	Clli
cf. Commandra pallida	bastard flax	Copa
Compositae	sunflower family	COMP
Conyza canadensis (L.) Cronq.		Coca
Cornus stolonifera Michx.	red-osier dogwood	Cost 1
Cruciferae	mustard family	CRUC
Delphinium sp.	larkspur	DELP
Eleocharis macrostachya Britt.	spikerush	Elma
Eriogonum jamesii Benth. var. jamesii	wee Mary buckwheat	Erja
Eriogonum jamesii var. flavescens Wats.	wee Mary buckwheat	Erja
Eriogonum leptophyllum (Torr.) Woot. & Standl.	buckwheat	Erle
Eriogonum racemosum Nutt.	redroot wild buckwheat	Erra

Table 2-1. (Continued).

Scientific Name	Common Name	Symbol
Eriogonum simpsonii Benth.	buckwheat	Ersi
Equisetum laevigatum A. Br.	scouring rush	Egla
Galium sp.	bedstraw	GALI
Glyceria grandis Wats.	American mannagrass	Glgr
Graminae	grass family	GRAM
Grindelia squarrosa (Pursh) Dunal. var. squarrosa	curleycup gumweed	Grsq
Gutierrezia microcephala (DC.) Gray	broom snakeweed	Gumi
Haplopappus spinulosus subsp. australis (Greene) Hall		Hasp
Heracleum lanatum Michx.	cowparsnip	Hela
Hilaria jamesii (Torr.) Benth.	galleta grass	Hija
Holodiscus dumosus (Nutt.) Heller	mountain spray	Hodu
Hordeum jubatum L.	foxtail barley	Hoju
Humulus americanus Nutt.	American hop	Huam
Hymenoxys richardsonii var. floribunda Gray (Parker)	pinque	Hyri
Hymenopappus sp.	white-ragweed	HYME 2
Iris missouriensis	flag	Irmi
cf. Juncaceae	rush family	JUNC 1
Juncus cf.balticus	wire-rush	Juba
Juncus tenuis var. dudleyi (Wieg.)	rush	Jute
Juncus sp.	rush	JUNC 2
Juniperus monosperma	oneseed juniper	Jumo
Juniperus scopulorum Sarg.	Rocky Mountain juniper	Jusc
Kochia scoparia (L.) Roth	summer-cypress	Kosc
Lappula redowskii (Hornem.) Greene	stickseed	Lare
Leucelene ericoides (Torr.) Greene		Leer
Lesquerella sp.	bladderpod	LESQ
Lupinus hillii Greene	red-hills lupine	Luhi
Lupinus sp.	lupine	LUPI
Machaeranthera sp.	aster	MACH
Medicago sativa L.	alfalfa	Mesa
Melilotus officinalis (L.) Lam.	sweetclover	Meof
Mentha sp.	mint	MENT
Mirabilis multiflora (Torr.) Gray	desert four o'clock	Mimu
Muhlenbergia cf. dubia	pine muhly	Mudu 1
Muhlenbergia montana (Nutt.) Hitchc.		Mumo
Muhlenbergia pauciflora (Buckl.)	New Mexico muhly	Mupa
Muhlenbergia sp.	muhly	MUHL
Opuntia polyacantha Haw. var. polyacantha	plains prickly pear	Oppo
Oryzopsis hymenoides (R.&S.) Ricker	indian ricegrass	Orhy
Oxytropis lambertii Pursh	Lambert crazyweed	Oxla
Parthenocissus inserta (Kerner) K. Fritsch	virginia creeper	Pain
Pericome caudata Gray var. caudata		Peca
Petradoria pumila (Nutt.) Greene subs. pumila		Pepu
Phleum sp.	timothy	PHLE
Pinus edulis Engelm.	pinyon pine	Pied
Pinus ponderosa Laws.	Ponderosa pine	Pipo
Poa fendleriana	muttongrass	Pofe

Table 2-1. (Concluded).

Scientific Name	Common Name	Symbol
Poa biglovii Vasey & Scribn.	Bigelow bluegrass	Pobi 1
Poa sp.	bluegrass	POA
Polemoneaceae	phlox family	POLE
Populus angustifolia James	narrowleaf cottonwood	Poan
Potentilla pennsylvanica L.	Pennsyslvania cinquefoil	Pope 2
Prunus virginiana L. var. melanocarpa (A. Nels.) Sarg.	chokecherry	Prvi
cf. Pseudocymopterus montanus		Psmo
Pseudotsuga menziesii (Mirabel) Franco var. glauca (Beissner) Franco	Douglas fir	Psme
Quercus gambellii	gamble oak	Quga
Rhus radicans L.	poison ivy	Rhra
Rhus trilobata Nutt.	squawberry	Rhtr
Ribes cereum Dougl.	wax current	Rice
Ribes leptanthum Gray	trumpet gooseberry	Rile
Ribes sp.	gooseberry	RIBE
Rorippa nasturtium-aquaticum (L.) Schinz & Thell.	watercress	Rona
Rosa woodsii Lindl.	rose	Rowo
cf. Schizacne purpurescens	false melic	Scpu
Rudbeckia laciniata L.	cutleaf coneflower	Rula
Salix exigua Nutt.	coyote willow	Saex
Scrophulariaceae	figwort family	SCRO
Sitanion hystrix (Nutt.) J.G. Smith	bottlebrush squirreltail	Sihy
Smilacina sp.	false solomon's seal	SMIL
Sporobolus cryptandrus	sand dropseed	Spcr
Symphoricarpos oreophilus Gray	mountain snowberry	Syor
Symphoricarpos sp.	snowberry	SYMPH
Stipa robusta (Vasey) Scribn.	sleepygrass	Stro
Stipa sp.	needlegrass	STIP
cf. Taraxacum sp.	dandelion	TARA
Thalictrum sp.	meadowrue	THER
Yucca baccata Torr.	datil	Yuba
Yucca cf. glauca	small soapweed	Yugl

Table 2-2. Summary of the Sagebrush/Grassland Habitat Site Vegetation Transects.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total hits[b]
Transect S-1						
Non-vegetative						
Litter	115	0	0	0	115	33
Bare Ground	42	0	0	0	42	12
Gravel	1	0	0	0	1	00
Manure	1	0	0	0	1	00
Subtotal	159	0	0	0	159	45
Vegetative						
Shrubs						
Artr	5	4	36	0	45	13
Gume	1	1	0	0	2	01
Subtotal	6	5	36	0	47	13
Grasses						
Agcr	22	96	1	0	119	34
Bogr	12	4	0	0	16	05
Sihy	1	4	0	0	5	01
Agsm	0	3	0	0	3	01
Subtotal	35	107	1	0	143	41
Forbs						
Oppo	0	1	0	0	1	00
Subtotal	0	1	0	0	1	00
TOTALS	200	113	37	0	350	100
Transect S-2						
Non-vegetative						
Litter	66	1	1	0	68	23
Bare Ground	37	0	0	0	37	12
Gravel	33	0	0	0	33	11
Subtotal	136	1	1	0	138	46

Table 2-2. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total hits[b]
Vegetative						
Shrubs						
Artr	15	14	57	0	86	29
Chna	1	1	0	0	2	01
Gume	1	1	0	0	2	01
Subtotal	17	16	57	0	90	30
Grasses						
Bogr	45	7	1	0	53	18
Agcr	1	11	0	0	12	04
Arfe	1	0	0	0	1	00
Sihy	1	0	0	0	1	00
Subtotal	48	18	1	0	67	23
Forbs						
ERIG	1	0	0	0	1	00
Leer	1	0	0	0	1	00
Subtotal	2	0	0	0	2	01
TOTALS	203	35	59	0	297	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

Table 2-3. Average density and height of shrub and tree species by habitat site.

Habitat Site	Species	N	Avg #/ acre	Avg ht. (ft)
Sagebrush/ Grassland	Artr	329	5530	1.3
	Gusa	13	210	< 1.0
	Pied	2	33	< 1.0
	Chna	2	33	< 1.0
Pinyon/Juniper Woodland	Artr	64	1067	1.0
	Pied	79	817	7.6
	Jusc	5	83	8.5
	Jumo	1	17	< 1.0
Upland Forest[a]	Jusc	23	192	7.5
	Pied	19	158	11.6
	Psme	19	158	11.2
	Lemo	10	83	3.7
	Jumo	6	50	8.6
	Pipo	4	33	16.5
Riparian	Prvi	54	900	4.5
	Alte	21	350	16.6
	Quga	2	33	5.5
	Jusc	1	17	3.0
Wooded Canyon Benches	Artr	49	817	1.5
	Gusa	11	183	< 1.0
	Jumo	5	83	8.4
	Pied	3	50	4.3
	Hodu	3	50	3.2
	Jusc	2	33	1.8
Canyon Slopes	Artr	57	950	2.3
	Syor	14	233	1.7
	Atca	8	133	2.0
	SYMP	6	100	1.8
	Hodu	6	100	4.3
	Chpa	4	67	3.3
	RIBE	2	33	2.5
Agricultural Land	Artr	6	100	< 1.0
	Chna	1	17	3.0

[a] The number of plots sampled in the Upland Forest was 12; in all other habitat sites six plots were sampled.

is generally characterized by small variations in species composition, community structure and low species diversity. Over most of its range, this habitat site is managed for grazing, and therefore, is subject to periodic intervention to improve its livestock carrying capacity. These management practices are probably the principal source of variation in the vegetative structure and composition within this habitat site.

Range management practices in many locations of this habitat site have focused on the destruction of big sagebrush and the introduction of crested wheatgrass. This has produced subareas within the habitat site which may be distinguished by their relative proportions of big sagebrush and crested wheatgrass.

Shrubs and grasses constituted about 53% of the total hits recorded within the habitat site, with big sagebrush acounting for approximately 25-55% of the vegetative hits (Table 2-2). The percent contribution of big sagebrush to total cover is dependent on the intensity of brush removal efforts. For example, most of step-point transect S-1 was located in an area that has been subjected to recent sagebrush removal practices. The sagebrush density was one half of the sagebrush density on Transect S-2 which is located in a relatively undisturbed site (Table 2-3).

Big sagebrush is returning to the areas from which it has been removed. Some minor invasions by pinyon pines (Pinus edulis) and junipers (Juniperus monosperma and J. scopulorum) were observed; in some areas where old stumps can be seen, pinyons and junipers may be reestablishing in artificially created areas of Sagebrush/Grassland. Despite this minor influx of pinyons and junipers, the potential vegetation community for this habitat site is probably a mixed grassland - shrub site characterized by big sagebrush and cool and warm season grasses (USDA/SCS, 1984a). Major grasses of the potential community include Indian ricegrass (Oryzopsis hymenoides), galleta (Hilaira jamesii), bottlebrush squirreltail (Sitania hystrix), and blue grama (USDA/SCS, 1984). When in poor condition this habitat site is characterized by big sagebrush, rubber rabbitbrush (Chrysothamnus nauseosus), snakeweed (Gutierrezia microcephala) and cactus (Opuntia sp.) (USDA/SCS, 1980b).

Bare ground, gravel, and litter are predicted to contribute about 80% of the ground cover in the potential community (USDA/SCS 1984). These non-vegetative components accounted for an average of 73 % of the basal hits on the transects (Table 2-2).

This habitat site covers approximately 6,250 acres within the project area and is confined largely to nearly level to gently sloping mesa lands and low rolling hills. The slopes vary from 1 to 5 % (USDA/SCS, 1982b). All aspects are represented in this habitat site on the study area. The soils are of the Fernando Hernandez Association. These soils are deep, well drained clay and silty, clay loams with high, available, water holding capacities. Effective rooting depth is five or more feet. Although this habitat site is found on plains, fans, and broad valley floors at elevations ranging from about 7,400 to about 8,000 ft in the project area, the majority of this habitat site occurs between 7,500 and 7,600 ft.

Pinyon-Juniper Woodland Habitat Site

The Pinyon-Juniper Woodland Habitat Site is the second most extensive habitat site in the project area, covering approximately 6,230 acres. It is a community with high species diversity; 39 species were encountered on the two transects conducted within this habitat site (Table 2-4). It is characterized by an extensive canopy of approximately 75% in some areas. An average of 41% of the vegetative hits recorded on both transects were canopy species with the pinyon pine (817 plants/acre) outnumbering the two juniper species (100 plants/acre) by almost an order of magnitude (Table 2-3). The two junipers hybridize throughout north central and northwestern New Mexico where their ranges overlap (Martin and Hutchins, 1980). Considerable hybridization was noted on the study area with many individuals displaying characteristics of both species. The three tree species averaged 7-9 ft in height (Table 2-3). The pinyon pines were predominantly in the mature and seedling age classes. The phenology of mature individuals was varied, ranging from the vegetative stage to bearing ripe seeds. The age class of the six junipers recorded in the plots ranged from seedling to decadent. The sample size was to small to describe their phenological stage during the sampling period.

Table 2-4. Summary of the Pinyon/Juniper Woodland Habitat Site Vegetation Transects.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total hits[b]
Transect PJ-1						
Non-vegetative						
Litter	98	0	1	0	99	27
Bare Ground	18	0	0	0	18	05
Rock	9	0	0	0	9	02
Gravel	7	0	0	0	7	02
Cobble	6	0	0	0	6	02
Subtotal	138	0	1	0	139	38
Vegetative						
Trees						
Pied	6	0	6	63	75	20
Jumo	0	0	2	9	11	03
Jusc	0	0	0	3	3	01
Pipo	0	0	0	1	1	00
Subtotal	6	0	8	76	90	24
Shrubs						
Ardr	1	1	10	0	12	03
Chna	3	5	0	0	8	02
Gume	1	1	0	0	2	01
Subtotal	5	7	10	0	22	06
Grasses						
Bogr	19	11	0	0	30	08
Agsm	5	19	0	0	24	06
AGRO	3	9	0	0	12	03
BROM	2	5	0	0	7	02
GRAM	2	2	0	0	4	01
Sihy	0	3	1	0	4	01
STIP	1	2	0	0	3	01
Bocu	1	1	0	0	2	01
Orhy	0	2	0	0	2	01
Subtotal	33	54	1	0	88	24

Table 2-4. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total hits[b]
Forbs						
Oppu	9	1	0	0	10	03
Pepu	2	5	0	0	7	02
Unid. forb	3	1	0	0	4	01
Erra	2	0	0	0	2	01
HYME	1	1	0	0	2	01
LESQ	0	2	0	0	2	01
Anse	1	0	0	0	1	00
Erja	1	0	0	0	1	00
Hyci	1	0	0	0	1	00
Yuba	1	0	0	0	1	00
Subtotal	21	10	0	0	31	08
TOTALS	203	71	20	76	370	100
Transect PJ-2						
Non-vegetative						
Litter	88	1	0	0	89	25
Gravel	31	0	0	0	31	09
Rock	18	0	0	0	18	05
Bare Ground	12	0	0	0	12	03
Cobble	9	0	0	0	9	03
Bedrock	2	0	0	0	2	01
Subtotal	160	1	0	0	161	45
Vegetative						
Trees						
Pied	2	1	4	63	70	20
Jusc	0	0	5	16	21	06
Jumo	0	0	4	5	9	03
Subtotal	2	1	13	84	100	28
Shrubs						
Ardr	1	5	2	0	8	02
Cemo	0	0	3	0	3	01
Subtotal	1	5	5	0	11	03

Table 2-4. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total hits[b]
Grasses						
MUHL	5	16	0	0	21	06
Bogr	13	5	0	0	18	05
Pofe	5	5	0	0	10	03
BROM	2	6	0	0	8	02
STIP	3	3	0	0	6	02
Bocu	1	3	0	0	4	01
GRAM	2	1	0	0	3	01
AGRO	0	1	0	0	1	00
Subtotal	31	40	0	0	71	20
Forbs						
Unid. forb	2	3	0	0	5	01
Oppu	2	0	0	0	2	01
Anse	0	2	0	0	2	01
Pepu	0	1	0	0	1	00
Erja	1	0	0	0	1	00
Chvi	1	0	0	0	1	00
MACH	1	0	0	0	1	00
Subtotal	7	6	0	0	13	04
TOTALS	201	53	18	84	356	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

In general, this habitat site is characterized by an extensive tree canopy cover with a moderate ground cover (24.5% avg. of basal hits) and a sparse brush canopy (9.8% avg. of vegetative hits) (Table 4). Big sagebrush is the most common shrub in this habitat site but is only 20% of its density in the Sagebrush/Grassland Habitat Site (Tables 2-3). Other shrubs, e.g. mountain mahogany (Cercocarpus montanus), and Ponderosa pines (Pinus Ponderosa) are found in the more mesic spots within the habitat site.

Although ground cover is sparse, this site supports numerous species of grasses; over 25% of the species encountered on the two transects were grasses (Table 2-4). No one grass species is dominant. The common grasses include blue grama, western wheatgrass (Agropyron smithii), bromes (Bromus sp.), muttongrass (Poa fendleriana), and needlegrass (Stipa sp.).

This habitat site occupies well drained slopes with shallow, rocky, soils of the Rock Outcrop-Raton Complex. This soil complex covers Guadalupe Mountain, Cerro Chiflo, and other hills in the area as well as the rims of the Rio Grande and Red River canyons. This complex consists of intermingled rock outcrop and very stony, silt loam. The Raton soil is strongly sloping to moderately steep. Rock outcrop is steep to very steep. The soil is shallow, well drained, and slowly permeable. The effective rooting depth is 10-20 inches. The available water capacity is very low, and runoff is rapid. The hazard of water erosion is moderate, and the wind erosion hazard is slight (USDA/SCS 1982b).

This habitat site occurs at all aspects on the study area. The elevation range is from 7,400 to 8,600 ft, which is the typical elevation range of the pinyon-juniper woodlands in Taos, Rio Arriba, and San Juan counties (USDA/SCS, 1982b).

The existing vegetation on this habitat site is similar to the potential natural vegetation described for it (USDA/SCS, 1978; 1982b). The potential vegetation is predicted to be a canopy of Colorado pinyon pine as the primary dominant, with junipers as the secondary dominant. Big sagebrush is uniformly dispersed through the association. This community may include scattered Ponderosa pine, generally at high elevations. The herbaceous understory

consists of mountain muhly (Muhlenbergia montanus), muttongrass, Arizona fescue (Festuca arizonica) and western wheatgrass.

The Pinyon-Juniper Woodland Habitat Site on the study area is generally mature and does not appear to be expanding significantly into the adjacent Sagebrush/Grassland areas nor is it being replaced by large conifers. The heavier soils and less effective drainage of these soils probably limits expansion into the Sagebrush/Grassland Habitat Site, and the lack of sufficient moisture probably limits the movement of large conifers into the Pinyon-Juniper Woodland Habitat Site. On the mesic areas of this habitat site, e.g., north slopes in narrow valleys, large conifers are more abundant. Similarly, some expansion of the pinyon-juniper woodland into the sagebrush/grassland areas can be seen where soil and drainage conditions are favorable, e.g., grasslands artificially created by clearing pinyon-juniper woodlands.

Upland Forest Habitat Site

The Upland Forest Habitat Site makes up 8.4% of the GMSA (1,570 acres). This community occurs at higher elevations where soils are well drained and poorly formed. It is an upland site occupying mountaintops and strongly sloping to very steep, mostly north-facing, slopes. The elevation range of this community on the study area is from 7600 to 8600 ft.

The soils are in the Rock Outcrop - Raton complex. This soil complex is described in the Pinyon-Juniper Woodland Habitat Site narrative.

This community is characterized by a mixed conifer overstory composed of pinyon pine (32% - average number of canopy hits), Rocky Mountain juniper (23%), one-seed juniper (19%), Ponderosa pine (15%) and Douglas fir (Pseudotsuga menziesii) (11%) (Table 2-5).

The average density and height of the tree species encountered in the plots are presented in Table 2-3. The small average height (11.2 ft) of the Douglas fir individuals is because more seedlings (N=11) were encountered than mature individuals (N=9). The phenology of the mature individuals of all

Table 2-5. Summary of the Upland Forest Habitat Site Vegetation Transects.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect MC-1						
Non-vegetative						
Litter	108	1	0	0	109	32
Cobble	22	0	0	0	22	06
Gravel	21	0	0	0	21	06
Rock	16	0	0	0	16	05
Bare Ground	11	0	0	0	11	03
Bedrock	5	0	0	0	5	01
Subtotal	183	1	0	0	184	54
Vegetative						
Trees						
Pied	0	0	5	17	22	06
Jusc	0	0	0	22	22	06
Pipo	0	1	0	16	17	05
Jumo	0	0	0	14	14	04
Psme	0	0	1	7	8	02
Subtotal	0	1	6	76	83	24
Shrubs						
Cemo	0	0	8	0	8	02
Quga	0	0	7	0	7	02
Syor	0	1	2	0	3	01
Artr	0	0	3	0	3	01
Subtotal	0	1	20	0	21	06
Grasses						
BROM	2	13	0	0	15	04
MUHL	5	6	0	0	11	03
STIPA	4	4	0	0	8	02
Arpu	2	1	0	0	3	01
Agcr	0	1	0	0	1	00
GRAM	0	1	0	0	1	00
Subtotal	13	26	0	0	39	11

Table 2-5. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Forbs						
Pepu	3	2	0	0	5	01
THERM	0	4	0	0	4	01
Luhi	0	2	0	0	2	01
Erra	1	0	0	0	1	00
DELP	0	1	0	0	1	00
COMP	0	1	0	0	1	00
Oxla	0	1	0	0	1	00
Psmo	0	1	0	0	1	00
Subtotal	4	12	0	0	16	05
TOTALS	200	41	26	76	343	100
Transect MC-2						
Non-vegetative						
Bare Ground	14	0	0	0	14	04
Litter	107	2	1	0	110	29
Gravel	19	0	0	0	19	05
Cobble	16	0	0	0	16	04
Rock	5	1	0	0	6	02
Bedrock	2	0	0	0	2	01
Subtotal	163	3	1	0	167	45
Vegetative						
Trees						
Pied	0	2	3	22	27	07
Jusc	1	1	5	20	27	07
Jumo	0	1	4	7	12	03
Pipo	0	0	0	9	9	02
Psme	1	0	0	4	5	01
Subtotal	2	4	12	62	80	21
Shrubs						
Cemo	2	3	17	0	22	06
Rice	0	0	3	0	3	01
Artr	0	0	1	0	1	00
Subtotal	2	3	21	0	26	07

Table 2-5. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Grasses						
BROM	11	21	0	0	32	09
MUHL	6	10	1	0	17	05
GRAM	5	11	0	0	16	04
Bogr	2	5	0	0	7	02
Sihy	1	2	0	0	3	01
Bocu	0	1	0	0	1	00
Subtotal	25	50	1	0	76	20
Forbs						
Pepu	3	2	0	1	6	02
Meof	3	3	0	0	6	02
Erja	2	1	0	0	3	01
Arpu	1	1	0	0	2	01
Unid. forb	1	1	0	0	2	01
ASTR	0	1	0	0	1	00
POLE	1	0	0	0	1	00
CRUC	0	1	0	0	1	00
Ipag	0	1	0	0	1	00
Coca	0	1	0	0	1	00
Chfr	0	1	0	0	1	00
Luhi	0	1	0	0	1	00
Subtotal	11	14	0	1	26	07
TOTALS	203	74	35	63	375	100
Transect T-1						
Non-vegetative						
Litter	82	0	0	0	82	30
Cobble	19	0	0	0	19	07
Gravel	17	0	0	0	17	06
Bedrock	11	0	0	0	11	04
Bare Ground	7	0	0	0	7	03
Rock	4	0	0	0	4	01
Subtotal	140	0	0	0	140	51

Table 2-5. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Vegetative						
Trees						
Jusc	0	0	1	23	24	09
Pied	0	0	1	14	15	05
Psme	0	0	0	15	15	05
Pipo	0	0	0	6	6	02
Subtotal	0	0	2	58	60	22
Shrubs						
Cemo	2	10	0	0	12	04
Quga	1	0	0	0	1	00
Subtotal	3	10	0	0	13	05
Grasses						
MUHL	27	5	0	0	32	12
BROM	19	0	0	0	19	07
Bocu	1	0	0	0	1	00
Orhy	0	1	0	0	1	00
Subtotal	47	6	0	0	53	19
Forbs						
THER	2	1	0	0	3	01
Pepu	2	0	0	0	2	01
DELP	1	0	0	0	1	00
HYME	1	0	0	0	1	00
Subtotal	6	1	0	0	7	03
TOTALS	196	17	2	58	273	100

Table 2-5. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect T-2						
Non-vegetative						
Litter	60	5	0	0	65	22
Gravel	31	0	0	0	31	10
Bare Ground	25	0	0	0	25	08
Cobble	16	0	0	0	16	05
Bedrock	2	0	0	0	2	01
Rock	1	0	0	0	1	00
Subtotal	135	5	0	0	140	47
Vegetative						
Trees						
Pied	1	3	0	19	23	08
Pipo	0	0	0	9	9	03
Jumo	1	1	0	7	9	03
Jusc	0	0	0	9	9	03
Psme	0	0	0	1	1	00
Subtotal	2	4	0	45	51	17
Shrubs						
Artr	2	6	1	0	9	03
Chva	5	3	0	0	8	03
Gumi	2	1	0	0	3	01
Syor	0	1	0	0	1	00
Subtotal	9	11	1	0	21	07
Grasses						
MUHL	19	4	0	0	23	08
BROM	22	0	0	0	22	07
AGRO	4	2	0	0	6	02
Orhy	4	0	0	0	4	01
Bogr	2	0	0	0	2	01
Subtotal	51	6	0	0	57	19

Table 2-5. (Concluded).

Species	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Forbs						
Pepu	5	4	0	0	9	03
HYME	4	2	0	0	6	02
LUPI	4	1	0	0	5	02
Unid. forb	2	0	0	0	2	01
Arpu	2	0	0	0	2	01
Erle	1	0	0	0	1	00
Oxla	1	0	0	0	1	00
Chvi	0	1	0	0	1	00
THER	1	0	0	0	1	00
Subtotal	20	8	0	0	28	09
TOTALS	217	34	1	45	297	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

canopy species varied from the vegetative stage to bearing ripe seeds. Seedlings were recorded for all tree species except one-seed juniper.

The understory is sparse (24% - average number of basal hits) and is dominated by Muhlenbergia and Bromus grasses (Table 2-5). The grasses in these two genera could not be identified to species because all of the individuals encountered in the field had disseminated seeds and had no remaining floral parts necessary for species identification.

A wide variety of shrub species (N=8) occur in this habitat site including big sagebrush, mountain mahogany, mountain snowberry (Symphoricarpos oreophilus), snakeweed and Gambel Oak (Quercus gambelii) (Table 2-5). Low densities of big sagebrush (8.3 individuals/acre) and moderate densities of mountain mahogany (83.3) (Table 2-3) were recorded in the plots. The other shrub species were only encountered on the transects. The mountain mahogany plants averaged 4 ft in height (Table 2-3), were either seedlings or mature, and mature plants had ripe seeds ready for dispersal. The sample size of big sagebrush individuals was too small to characterize their height, age class, and phenology in this habitat site.

This habitat has characteristics of both the the pinyon-juniper woodland of lower elevations and the mixed conifer forest at higher elevations. Therefore the potential natural vegetation probably includes the Pinyon-Juniper/Big Sagebrush Association described in the Pinyon-Juniper Woodland Habitat Site and the Ponderosa Pine/Douglas Fir Association (USDA/SCS, 1978). The Ponderosa Pine/Douglas Fir Association is a community with Ponderosa pine as the dominant and Douglas fir as the sub-dominant species. The brushy understory typically includes snowberry, rock-spiraea (Holodiscus dumosus) and gooseberry (Ribes sp.). Limited grass production is present, but includes Arizona and Thurber fescues (Festuca thurberi) and mountain brome (Bromus marginatus). Guadalupe Mountain apparently does not attain climatic and edaphic conditions necessary for a true mixed conifer forest.

Wooded Canyon Benches Habitat Site

The Rio Grande and Red River canyon slopes are comprised of two habitat sites, Wooded Canyon Benches and Canyon Slopes (Appendix A). The Wooded Canyon Benches Habitat Site occupies slightly more acreage on the study area (1720 acres) than the Canyon Slopes Habitat Site (1690 acres). Twenty six species were recorded on the two transects conducted in the Wooded Canyon Benches Habitat Site. Total vegetative cover averages 52% with a moderate canopy coverage (avg. 36% of total vegetative hits), and an avg. of 26% ground cover, comprised predominantly of grasses (Table 2-6). Elevations of this habitat site range from 6,600 ft at the confluence of the two rivers to an average of 7,500 ft at the canyon rims.

The canopy layer in this habitat site is similar in total cover (avg 20% of the total hits) and species composition to that of the Upland Forest Habitat Site. The major difference between the canopy composition of the two habitat sites is the abundance of Douglas fir. Douglas fir is almost absent in the canyons but is one of the major canopy species in the Upland Forest Site. It's absence in the canyon is probably related to the more xeric condition of this site.

As in the Upland Forest Habitat Site, juniper densities are higher than pinyon pine densities in this habitat site. This is in contrast to the Pinyon-Juniper Woodland Habitat Site in which the pinyon pine is much more abundant than the two juniper species (Table 2-3).

Three shrub species were recorded in this habitat site, big sagebrush, snakeweed, and rock-spiraea. Shrub densities in this habitat site are equivalent to densities in other habitat sites on the study area. The average height of the shrub species ranged from < 1 ft for snakeweed to 3 ft for rock-spiraea (Table 2-3). All age classes were represented for all three shrub species. Mature big sagebrush individuals were predominantly in the vegetative stage, and mature snakeweed and rock-spiraea individuals were flowering or bore ripe seeds.

Table 2-6. Summary of the Wooded Canyon Benches Habitat Site Vegetation Transect.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect Cw/-1						
Non-vegetative						
Litter	73	2	0	0	75	20
Rock	56	0	0	0	56	15
Gravel	20	0	0	0	20	05
Cobble	14	0	0	0	14	04
Bare Ground	4	0	0	0	4	01
Subtotal	167	2	0	0	169	46
Vegetative						
Trees						
Jumo	2	0	5	22	29	08
Pied	0	0	2	23	25	07
Pipo	0	0	0	15	15	04
Jusc	0	0	2	3	5	01
Subtotal	2	0	9	63	74	20
Shrubs						
Artr	4	1	13	0	18	05
Hodu	1	2	8	1	12	03
Subtotal	5	3	21	1	30	08
Grasses						
POA	6	14	0	0	20	05
Agsm	4	14	0	0	18	05
Bogr	8	1	0	0	9	02
MUHL	2	7	0	0	9	02
Bocu	1	4	1	0	6	02
CARE	1	4	0	0	5	01
AGRO	1	3	0	0	4	01
Sihy	1	2	0	0	3	01
BROM	1	1	0	0	2	01
Spcr	1	1	0	0	2	01
Subtotal	26	51	1	0	78	21

Table 2-6. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Forbs						
Arca	0	8	0	0	8	02
Arfr	0	5	0	0	5	01
Oppo	4	0	0	0	4	01
unid. forb	1	0	0	0	1	00
Subtotal	5	13	0	0	18	05
TOTALS	205	69	31	64	369	100
Transect Cw/-2						
Non-vegetative						
Litter	80	2	1	4	87	24
Rock	38	2	8	0	48	13
Gravel	23	0	0	0	23	06
Cobble	14	0	0	0	14	04
Bare Ground	9	0	0	0	9	02
Subtotal	164	4	9	4	181	50
Vegetative						
Trees						
Jumo	3	0	3	14	20	06
Pipo	0	0	0	18	18	05
Pied	0	0	0	12	12	03
Jusc	0	0	3	5	8	02
Psme	0	0	0	7	7	02
Subtotal	3	0	6	56	65	18
Shrubs						
Artr	1	1	14	0	16	04
Gumi	1	2	0	0	3	01
SYMP	0	1	0	0	1	00
Subtotal	2	4	14	0	20	06

Table 2-6. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Grasses						
Bogr	10	8	0	0	18	05
POA	2	8	2	0	12	03
Ansc	3	5	2	0	10	03
CARE	1	8	0	0	9	02
MUHL	2	6	0	0	8	02
Agsm	1	2	0	0	3	01
Orhy	2	0	0	0	2	01
Bocu	0	1	0	0	1	00
GRAM	1	0	0	0	1	00
Sihy	0	0	1	0	1	00
Spcr	0	1	0	0	1	00
Subtotal	22	39	5	0	66	18
Forbs						
Arlu	3	14	0	0	17	05
Oppo	4	0	0	0	4	01
Ersi	1	2	0	0	3	01
Hyri	1	2	0	0	3	01
CRUC	2	0	0	0	2	01
Chvi	0	2	0	0	2	01
Subtotal	11	20	0	0	31	09
TOTALS	202	67	34	60	363	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

Twelve species of grasses were recorded on this site. The most abundant species were Poa sp., blue grama, little bluestem (Andropogon scoparius) and western wheatgrass. These grasses constituted an average of 44% of the herbaceous vegetative hits (layers 1 and 2 - Table 2-6).

The soils in this habitat site are of the Orthents-Rock Outcrop association (USDA/SCS, 1982b). This association consists of very steep soils (70% of association) and rock outcrops (30%). The soils are deep, well drained, very gravelly or cobbly loams on slopes that range from 40 to 80%. The soils formed in material derived from old alluvium of the Santa Fe Formation. Permeability varies from moderately rapid to moderate and the effective rooting depth is $\geq$ 60 inches. The available water capacity is very low. Runoff is rapid and the water erosion hazard is high. The rock outcrops are nearly vertical escarpments of basalt that form a protective cap over the alluvial sediment. The rock outcrops are along the borders of this association (USDA/SCS 1982b).

Because this habitat site has low potential for grazing (USDA/SCS 1982b) and other human activities it has probably not been disturbed drastically. Therefore the existing vegetation is probably representative of the potential natural vegetative community, a pinyon-juniper/Ponderosa pine association where pinyon pine and junipers are primary dominants with Ponderosa pine as the secondary dominant. Usually this association is found with a moderately open canopy and no appreciable woody understory is present. Herbaceous understory is variable, depending on elevation, aspect, and local soils.

Canyon Slopes Habitat Site

The second habitat site in the canyons is the Canyon Slopes Habitat Site. The vegetative cover of this habitat site is similar to the Wooded Canyon Benches Habitat Site; an average of 51% of the total hits in the Wooded Canyon Benches Habitat Site (Table 2-6) and an average of 45% of the total hits in the Canyon Slopes Habitat Site (Table 2-7) were vegetative. However, the vegetative structure of these two habitat sites is very different. Unlike the Wooded Canyon Benches Habitat Site, the Canyon Slopes Habitat Site has a

Table 2-7. Summary of the Canyon Slopes Habitat Site Vegetation Transect.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect Cw/o-1						
Non-vegetative						
Rock	96	0	3	0	99	28
Litter	39	0	1	0	40	11
Cobble	25	0	0	0	25	07
Bare Ground	9	0	0	0	9	03
Gravel	8	0	0	0	8	02
Sand	8	0	0	0	8	02
Subtotal	185	0	4	0	189	53
Vegetative						
Trees						
Jumo	0	0	0	6	6	02
Jusc	0	0	0	5	5	01
Subtotal	0	0	0	11	11	03
Shrubs						
Artr	3	4	33	1	41	11
Hodu	0	1	20	0	21	06
Syor	3	4	10	0	17	05
Prvi	0	2	3	0	5	01
Chpa	1	0	3	0	4	01
RIBE	1	0	3	0	4	01
SYMP	0	0	3	0	3	01
Rhtr	0	0	1	0	1	00
Subtotal	8	11	76	1	96	27
Grasses						
MUHL	3	10	0	0	13	04
AGRO	2	9	0	0	11	03
Spcr	2	5	0	0	7	02
Orhy	2	4	0	0	6	02
POA	4	1	0	0	5	01
Sihy	0	3	0	0	3	01
Agsm	1	1	0	0	2	01
Bogr	1	1	0	0	2	01
Brte	0	1	0	0	1	00
Subtotal	15	35	0	0	50	14

Table 2-7. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Forbs						
Arlu	1	2	1	0	4	01
Arca	0	2	0	1	3	01
Leer	0	3	0	0	3	01
Unid. moss	2	0	0	0	2	01
Subtotal	3	7	1	1	12	03
TOTALS	211	53	81	13	358	100
Transect Cw/o-2						
Non-vegetative						
Rock	64	0	2	0	66	19
Cobble	46	0	0	0	46	14
Gravel	37	0	1	0	38	11
Litter	37	1	0	0	38	11
Bare Ground	7	0	0	0	7	02
Subtotal	191	1	3	0	195	57
Vegetative						
Trees						
Jumo	0	0	1	7	8	02
Jusc	0	0	0	2	2	01
Pied	0	0	1	0	1	00
Subtotal	0	0	2	9	11	03
Shrubs						
Artr	2	3	24	0	29	09
Atca	2	1	9	1	13	04
Subtotal	4	4	33	1	42	12

Table 2-7. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Grasses						
Bocu	7	17	2	0	26	08
Orhy	3	14	0	0	17	05
Spcr	1	12	0	0	13	04
Bogr	2	6	0	0	8	02
Boer	1	4	1	0	6	02
Mupa	2	4	0	0	6	02
Sihy	2	4	0	0	6	02
Subtotal	18	61	3	0	82	24
Forbs						
CRUC		3	1		4	01
Oppo	3				3	01
Arlu		2			2	01
Leer	1	0			1	00
Subtotal	4	5	1	0	10	03
TOTALS	217	71	42	10	340	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

sparse canopy (7.5% avg. of the vegetative hits), and a sparse ground cover (12% avg. of basal hits).

The differences in the two canyon habitat sites can probably be attributed to the soil and water conditions of the two sites. The soil complex of the Canyon Slopes Habitat Site is Rock Outcrops, very steep (USDA/SCS, 1982b). It consists mainly of basalt that have some layers of terrace sediment. Slopes are very steep and local relief is 50-600 ft. Runoff is very rapid and the erosion hazard is slight. The only vegetation that occurs in this habitat site are species that can establish in these severe soil and moisture conditions.

The sparse tree canopy is dominated by one-seed and Rocky Mountain junipers. These occur at such low densities that none were encountered in the plots.

The brush canopy density (1616 plants/acre) is 1.65 times the brush canopy density in the Wooded Canyon Benches Habitat Site (1,050 plants/acre) (Table 2-3). This habitat site supports the densest brush canopy of any of the seven habitat sites on the study area.

The average height of the shrub species ranged from 2-4 ft (Table 2-3) and the majority of individuals in all species with the exception of snowberry, were in reproductive stages. All snowberry individuals encountered in the plots were in the vegetative stage. Few seedlings of any species were found in the plots.

Sixteen species were recorded in the herbaceous layer of which 12 species were grasses. The most abundant grass species were side-oats grama (Bouteloua curtipendula) and Indian ricegrass which comprised an average of 27% of the vegetative basal hits (Table 2-7).

Although the potential natural vegetation has not been described in the literature, this habitat site is probably a seral stage. As the plants break down the rock outcrops and soil is produced, the site will probably undergo succession resulting in the Wooded Canyon Benches Habitat Site as the climax

community. Portions of this habitat site are bare, talus slopes that could be considered even earlier seral stages of this ongoing succession. Although these slopes probably have a plant community that differs from the sampled community of this habitat site, these slopes were not sampled due to their inaccessibility.

Agricultural Land Habitat Site

This habitat site only occurs on the Molycorp, Inc. property within the study area (Appendix A). It comprises only about 2.2% (420 acres) of the study area and includes all agricultural lands surrounding Molycorp's tailings areas, approximately 800 acres of dams and settling ponds. The tailings areas have been subjected to reclamation experiments since 1975 (USDA/SCS, 1981; 1982c). Many native and exotic shrub, grass, and forb species have been introduced on the tailings areas. These introductions have probably affected the species composition of the surrounding agricultural lands which are owned by Molycorp and are fallow. Therefore, the plant species composition of the habitat site on the study area is probably a result of the reproduction of the species orginally planted on these lands when it was farmed, and invasion of species introduced on the adjacent tailings areas and other agricultural properties.

The plant community associated with this habitat site consists of a dense herbaceous layer (avg. of 56.3% of vegetative hits) (Table 2-8) with scattered shrubs (3.3%) and trees (0.4%) in the windrows that border the agricultural properties.

The species composition of the two agricultural areas sampled by Transects A-1 and A-2 were markedly different, as a result of the continual disturbance to this habitat site from tailings and agricultural activities. The herbaceous cover on Transect A-2 was dominated by sleepy grass (Stipa robusta), summer cypress (Kochia scoparia) and curlycup gumweed (Grindelia squarrosa) which comprised 78% of the vegetative hits (Table 2-8).

Transect A-1 is located closer to from the active tailings and reclamation areas than Transect A-2 and has been used more recently for agricultural

Table 2-8. Summary of the Agricultural Lands Habitat Site Vegetation Transects.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect A-1						
Non-vegetative						
Litter	117	0	0	0	117	30
Bare Ground	19	0	0	0	19	05
Gravel	8	0	0	0	8	02
Subtotal	144	0	0	0	144	37
Vegetative						
Trees						
Jusc	0	0	0	2	2	01
Subtotal	0	0	0	2	2	01
Grasses						
Stro	8	37	13	0	58	15
Brin 1	9	19	8	0	36	09
Mesa	3	26	7	0	36	09
Agcr	8	16	0	0	24	06
Agsm	4	8	0	0	12	03
Scpu	6	6	0	0	12	03
GRAM	1	9	0	0	10	03
Agtr	1	7	0	0	8	02
Hoju	3	3	1	0	7	02
Brci	1	1	0	0	2	01
JUNC 2	0	1	1	0	2	01
Besy	0	0	1	0	1	00
JUNC 1	0	1	0	0	1	00
POA	0	1	0	0	1	00
Sihy	0	1	0	0	1	00
Subtotal	44	136	31	0	211	54
Forbs						
Kosc	9	2	0	0	11	03
COMP	5	5	0	0	10	03
unid. seedlings	4	0	0	0	4	01
Grsq	1	1	0	0	2	01
Irmi	2	0	0	0	2	01
MACH	0	2	0	0	2	01
Subtotal	21	10	0	0	31	08
TOTALS	209	146	31	2	388	100

Table 2-8. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect A-2						
Non-vegetative						
Litter	91	0	0	0	91	30
Bare Ground	38	0	0	0	38	12
Gravel	12	0	0	0	12	04
Subtotal	141	0	0	0	141	46
Vegetative						
Shrubs						
Chna	1	2	5		8	03
Artr		2	1		3	01
Subtotal	1	4	6	0	11	04
Grasses						
Stro	8	36	8	0	52	17
Agcr	1	5	0	0	6	02
JUNC 1	1	1	0	0	2	01
GRAM	1	0	0	0	1	00
Mesa	0	1	0	0	1	00
Subtotal	11	43	8	0	62	20
Forbs						
Kosc	36	27	0	0	63	21
Grsq	3	10	0	0	13	04
MACH	4	5	1	0	10	03
Hasp	1	1	0	0	2	01
COMP	1	0	0	0	1	00
Meof	0	1	0	0	1	00
unid. forb	1	0	0	0	1	00
Subtotal	46	44	1	0	91	30
TOTALS	199	91	15	0	305	100

[a] The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b] 00 represents any value < 0.5%.

purposes. This is reflected by the higher number of species recorded on this transect (22 species) in comparison with Transect A-2 (14 species). The plant community sampled by Transect A-1 was dominated by sleepy grass, alfalfa (Medicago sativa) , Hungarian brome (Bromus inermis), and crested wheatgrass. These four species comprised 63% of the vegetative hits on Transect A-1. The two sampled plant communities had large numbers of native grasses and annual forbs, and introduced species associated with disturbed sites, e.g., summer cypress, aster (Machaeranthera sp.), crested wheatgrass, and Hungarian brome. However, none of the dominant species recorded on the two transects were reported as reclamation species on Molycorp's tailings areas (USDA/SCS, 1981; 1982c).

Few shrubs and no trees were encountered in the shrub and tree characterization plots. The only shrub species encountered in the plots (Table 2-3) and along the transects (Table 2-8) were big sagebrush and rubber rabbitbrush. One Rocky Mountain juniper was encountered along the transects.

The soils of the Agricultural Land Habitat Site and the tailings areas range from sandy loams to sandy clays with alternating layers of heavy clay (USDA/SCS, 1981). This habitat site is located at approximately 7,500 ft on the study area; the aspect is generally south and slopes are gentle, usually less than 1%. This area receives 11-13 in. of rainfall annually, predominantly between March and October (USDA/SCS, 1981).

According to the Soil Conservation Service (SCS) (USDA/SCS, 1981), the potential vegetation for this habitat site (as represented by undisturbed sites) contains the following species: pinyon pine, Apache plume (Fallugia paradoxa), wood's rose (Rosa woodsii), Gambel oak, gooseberry, mountain brome, hairy grama (Bouteloua hirsuta), muttongrass, and mountain muhly. Other species typically found in the area include western wheatgrass, needle and thread, big sagebrush, junegrass (Koeleria cristata), blue grama, Arizona fescue, and galleta.

Riparian Habitat Site

The Riparian Habitat Site within the study area is limited to a very narrow band along the banks of the Red River and local springs (Appendix A). The vegetative community of this habitat site is comprised of deciduous trees, shrubs, and vines growing along the river's edge and around springs. This community has the highest number of species (N=44) of any of the habitat sites on the study area (Table 2-9). A primary reason this habitat site exists here is because it is adjacent to a stable perennial water source. Although the Rio Grande within the study area is also perennial, its water level fluctuates dramatically precluding the establishment of a dense riparian community along its banks.

Unlike some of the previously discussed habitat sites, no single species is dominant within the plant community. The most common species, thinleaf alder (Alnus tenuifolia), western black chokecherry (Prunus virginiana), western virgin's bower (Clematis ligusticifolia), and Bigelow bluegrass (Poa bigelovii) accounted for only an average of 34% of the total hits (Table 2-9). The vegetative structure within this habitat site is more complex than that of any other site. The shrub and tree canopy layers (#'s 3 and 4) had an average of 56 and 98% of the vegetative hits respectively (Table 2-9). Ninety-four percent of the individuals in the shrub and tree plots were chokecherry and thinleaf alder (Table 2-3). The chokecherry individuals averaged 4.5 feet in height and were saplings and in the vegetative stage. The thinleaf alder individuals averaged 16.6 feet in height (Table 2-3) and were evenly distributed among the mature, sapling, and seedling age classes. The mature individuals all had ripe seeds.

Of 898 hits recorded on the two transects, 67% were vegetative hits. However, 72% of the basal hits were non-vegetative material (Table 2-9). Thus, while ground cover is low (28% avg. of basal hits) relative to other habitat sites, total vegetative cover is high due to the canopy development in this habitat site.

Table 2-9. Summary of the Riparian Habitat Site Vegetation Transects.

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Transect R-1						
Non-vegetation						
Litter	105	10	0	0	115	22
Rock	41	0	0	0	41	08
Bare ground	7	0	0	0	7	01
Sand	2	0	0	0	2	00
Cobble	1	0	0	0	1	00
Gravel	1	0	0	0	1	00
Silt	1	0	0	0	1	00
Styrofoam	1	0	0	0	1	00
Water	1	0	0	0	1	00
Subtotals	160	10	0	0	170	32
Vegetative						
Trees						
Alte	1	6	16	70	93	18
Prvi	0	18	32	22	72	14
Psme	0	1	0	6	7	01
Jusc	0	0	1	5	6	01
Subtotal	1	25	49	103	178	34
Shrubs						
Rile	0	17	0	4	21	04
Rowo	0	7	3	0	10	02
SYMP	0	7	0	0	7	01
Artr	3	1	0	0	4	01
Hodu	0	1	1	0	2	00
Rhtr	0	0	1	0	1	00
Cost	0	1	0	0	1	00
Subtotal	3	34	5	4	46	09
Grasses						
Agtr	12	9	1	0	22	04
Brci	4	1	0	0	5	01
Cane	1	1	0	0	2	00
Brte	0	1	0	0	1	00
Muhl	0	1	0	0	1	00
Subtotal	17	13	1	0	31	06

Table 2-9. (Continued).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Forbs						
Clli	8	16	16	0	40	08
Rula	2	15	1	0	18	03
Pain	3	2	7	1	13	02
APOC	0	4	5	0	9	02
Huam	1	3	2	0	6	01
Hela	1	2	0	0	3	01
Peca	0	3	0	0	3	01
GALI	1	1	0	0	2	00
Rona	2	0	0	0	2	00
Armi	0	1	0	0	1	00
CIRS	0	1	0	0	1	00
ERIG	1	0	0	0	1	00
MENT	1	0	0	0	1	00
Subtotal	20	48	31	1	100	19
TOTALS	201	130	86	108	525	100
Transect R-2						
Non-vegetation						
Litter	62	1	0	0	63	18
Rock	24	0	0	0	24	07
Bare ground	19	0	0	0	19	05
Gravel	12	0	0	0	12	03
Sand	4	0	0	0	4	01
Subtotals	121	1	0	0	122	34
Vegetative						
Trees						
Alte	1	0	1	48	50	14
Quga	2	3	2	16	23	06
Jusc	2	0	0	22	24	07
Prvi	0	4	6	1	11	03
Psme	0	0	0	2	2	01
Subtotal	5	7	9	89	110	31

Table 2-9. (Concluded).

Species[a]	Hits by Canopy Level 1	2	3	4	Total Hits	% of Total Hits[b]
Shrubs						
Rowo	0	10	4	2	16	04
Cost	3	3	0	0	6	02
Saex	2	2	1	0	5	01
Rile	2	1	0	0	3	01
Chna	0	2	1	0	3	01
Rhtr	0	1	1	0	2	01
SYMP	1	1	0	0	2	01
Rhra	0	1	0	0	1	00
Subtotal	8	21	7	2	38	11
Grasses						
Pobi	30	1	0	0	31	09
Agtr	12	1	0	0	13	04
Elca	3	4	1	0	8	02
Brci	1	1	0	0	2	01
Subtotal	46	7	1	0	54	15
Forbs						
Eqla	6	4	0	0	10	03
Clli	0	5	3	0	8	02
Rula	0	4	0	0	4	01
CIRS	1	1	0	0	2	01
Huam	1	1	0	0	2	01
Cane	1	0	0	0	1	00
Elma	1	0	0	0	1	00
Hela	0	1	0	0	1	00
Pain	1	0	0	0	1	00
SMIL	0	1	0	0	1	00
THAL	0	1	0	0	1	00
Subtotal	11	18	3	0	32	09
TOTAL	191	54	20	91	356	100

[a]The species codes are the first two letters of the generic name and the first two letters of the species name. A complete list of species are presented in Table 2-1.

[b]00 represents any value < 0.5%.

The common plants within this habitat site are restricted to this site within the study area. However, mesic species common in other habitat sites, e.g., Rocky Mountain juniper, Douglas fir, and Gambel oak occur in low numbers in this habitat site.

This habitat site covers approximately 90 acres in the project area, but because of its uniqueness, proximity to permanent water, diversity, and heterogenous vegetative structure, it is an important avian habitat site (Section 3.0). The Red River enters the habitat site at 7,200 ft and leaves it at 6,900 ft. The slopes of the Red River canyon range from 40 to 80%.

The soils in this habitat site are principally overbank deposits of the Orthents-Rock Outcrop Association. This association is described in the Wooded Canyon Benches Habitat Site narrative.

Outside the study area this habitat site is widely scattered throughout north central New Mexico along the banks of perennial streams and springs not subject to marked water level variation. This habitat site is probably not a seral stage but is a climax community for the narrow stream bank zone it occupies.

3.0 AVIAN OCCURRENCE BY HABITAT SITE

One of the primary objectives of this study was to document and quantify the avian prey within the study area that would be available to Peregrine Falcons if they nest in nearby suitable habitat. In order to quantify avian populations, a censusing grid was established in each of the seven habitat sites identified in Section 2.0. The methods and results of these population studies are described below.

Methods

Grid Selection and Layout

The locations of the seven spot-mapping grids were selected after preliminary habitat maps of the study area had been completed. Grids that were located within large tracts of homogenous habitat were selected on the following criteria:

- grid boundaries were at least 1/8 mi. from the edges of other habitat sites,
- no unusual enclave of another habitat site or special habitat feature (e.g., cliff, deep arroyo) totalling more than one acre were included within its boundaries,
- each grid was accessible and traversable,
- grid corners were well documented from established section corners or other permanent points for future relocation, and
- each grid was 8 to 10 ha (20-30 acres) in size.

For grids that were located in narrow habitat sites (Riparian and Canyon Slopes) or a habitat site with limited area (Agricultural Lands), meeting the first criteria was not required. Final grid locations are shown on the Avian Habitat Map (Appendix A).

One external corner of each grid was established by plane survey from a USGS brass cap or other permanent definable point. The remaining exterior grid corners and all interior grid points were then established by standard plane surveying techniques. Corners were staked with 1/2 in. rebar driven at least 18 in. into the ground and extending at least 2 ft. above the surface.

Interior grid points were marked with flagging tape and spray paint, usually on a nearby tree, rock, or a wooden stake driven at the surveyed point. A letter and number denotation (i.e., A1 in northeast corner of grid) was also marked on each grid point so that the observer would always be able to locate their position on the grid.

A master map of each grid was prepared showing the denoted grid points and identifiable features such as rock outcrops, drainages, or identifiable trees and snags. Each grid map was reproduced on 8 1/2 x 11 in. paper (Appendix B) for easy field use on a standard clipboard. Color prints and slides document all exterior grid corners (Appendix C).

Avian Censusing

Birds were censused on the study area using the International Bird Plot Census (Spot Mapping) Method which involves repeated counts of birds occurring within a sample of homogenous habitat. Spot mapping was developed by Williams (1936) as a means of determining breeding bird densities and has since served as the principle technique for estimating densities of small, non-flocking territorial birds. Because of the popularity of this technique, census methods were standardized in 1969 by the International Bird Census Committee (IBCC; 1969, 1970). No censusing method is applicable in every instance or is without its drawbacks. Many workers regard the spot-mapping method as providing a reliable absolute density estimate which, in fact, has been found to be above 90% in accuracy for the majority of species examined in a northern Arizona study (Franzreb 1981). If the observer can obtain an accurate count of the number of territorial males, then a reasonably good estimate of breeding bird density can be calculated. However, the disadvantages of this technique are:

- it is not effective for flocking or non-territorial species (IBBC 1970),
- it is applicable only during the breeding season (Edwards et al. 1981),
- it requires considerable time and effort in grid layout and censusing (Emlen 1971),

- it is applicable only to relatively small tracts of homogenous habitat (Marchant 1981),
- there can be considerable variation in interpretation of cumulative maps (Best 1975), and
- the result of multiple censuses is one cumulative sample of the number of territories per grid; therefore, statistical tests of variances and significances cannot be easily applied (Eagles 1981).

During censusing, observers traversed the grid, looking and listening for birds. Each contact, called a registration, was plotted on the grid map. Registrations that were indicative of territorial behavior, such as a singing male or boundary dispute, were particularly important. Each registration also contained coded information on the bird's identity, sex (if it could be determined), song (presence and type), and behavior. Standard IBCC (1970) mapping codes were used. Constant effort was made to track movements of individuals so that multiple registrations of the same bird did not occur. All nests found were also recorded.

Each grid was censused seven times between April 9 and June 22, 1985. This period was chosen because it coincided with the most critical phases, incubation (mid-April to mid-May) and nestling (mid-May to late June) rearing, of Peregrine Falcon reproductive activity. No less than eight or more than twelve days elapsed between counts on each grid. Inventories were completed within 180 minutes of sunrise, which was defined as the time when first light enabled the observer to see flagged stakes within the grid. This was 20-30 minutes before official sunrise. Counts were not conducted on rainy or windy (> 12 mph winds; Beaufort rating of 3) mornings. Two observers conducted all censuses, alternating so that each grid was censused approximately equally by each observer.

Data for each census was recorded on a fresh map. The results of each census were also summarized on a BLM Daily Inventory Summary Form. Copies of all completed maps and forms were submitted to the BLM Taos Resource Area Office with this report. After completion of the counts in the field, each observer prepared a composite map for each species on each grid for the

censuses they had conducted. These maps were combined, thereby placing the results of all seven counts on one map. The two observers then independently estimated the number of breeding pairs of each species on each grid. At least two registrations, both having high territorial significance (e.g., song; IBCC 1970) were required for a territory to be delineated. A nest found on a grid was also considered evidence of a breeding pair. Observers also classified non-breeders as either visitors, species seen or heard on a grid at least once, or partial breeders, species having at least a portion (but less than half) of their territory on a grid. Results of the two observers' estimates were averaged to provide population estimates. To maintain consistency with IBCC (1970) standards (whole or half territories only), an average of X.25 (X = 0 or an integer) was rounded up to X.5, one ending in X.75 was rounded down to X.5. Differences between observer density estimates within grids and between grids were tested with an Analysis of Variance; because of the single sample dilemna mentioned above differences between sampling periods could not be measured with statistical methods.

Breeding pairs of birds per square kilometer (km^2) were calculated from census results so that comparisons could be made with published accounts of previous spot-mapping studies in similar habitats. Data from two or more years of counts on the same grid were averaged before comparing them with counts from GMSA grids. This had a stabilizing effect on that data, since increased sampling increased the validity of the means. Therefore ranges for these grids are also given when comparisons are made with GMSA grids. Multiple years of data also increases the chance of less common species being encountered on a grid; thus the number of species encountered during long term (2-3 years) studies would be expected to be more than in the 1-year GMSA study.

The number of breeding pairs expected to occur within each habitat site was calculated based on the total acreage of that habitat site in the GMSA. Because we have only a single sample for each habitat site, it was not possible to determine confidence limits for these population estimates, though ranges are provided by the estimates made by the two observers. However, this lack of an estimate of variance decreases the predictive value of these habitat site population estimates.

Species diversity indices were calculated for all grids, both on the GMSA and from previous studies, using the equation,

$$H = -\Sigma P_i \ln(P_i)$$ (MacArthur and MacArthur 1961).

For calculations the formula becomes

$$H = \ln N - 1/N \Sigma n_i (\ln n_i)$$

where n = number of individuals of the i^{th} species and N = total number of individuals. Species diversity indices of the seven habitat sites within the GMSA were compared to each other as well as to the indices calculated for previously published censuses in similar habitats.

Results

Tests of Observer Variability

Because most species on all grids had three or fewer breeding pairs, species were lumped into two categories before analysis; those species which were most likely to be seen first (visual cues) and those species which were most likely to be heard first (auditory cues) (Table 3-1). In three of four cases the data are not normally distributed (Table 3-2). Therefore the data were analyzed for observer differences with a Willcoxon 2-Sample test for non-parametric data (Table 3-3). The results of this test indicate that 1) there was no significant difference between observers (Probability of $> Z = 0.47$) and 2) there was a highly significant difference between species separated by cue (Probability of $> Z = 0.0025$). Interaction between observers and cues could not be tested.

Avian Communities of the GMSA

A total of 85 species of birds were recorded on or flying over one or more of the seven census grids. An additional 48 avian species were recorded within the GMSA but not on a grid (Appendix D). The species list of 133 birds is presented in Table 3-4. A discussion of the bird populations on each of the seven habitat sites follows; habitat sites are discussed in the same order as in Section 2.0.

Table 3-1. Estimates of total breeding pairs on each grid by each observer.

Habitat Site	Number of Breeding Pairs			
	Observer #1		Observer #2	
	Visual[a]	Auditory[b]	Visual	Auditory
Sagebrush/Grassland	2.5[c]	17	0	15.5
Pinyon/Juniper Woodland	8	28	5	23.5
Upland Forest	7.5	36	4	33.5
Wooded Benches	6	29	4	30
Canyon Walls	6	32	4	32.5
Agriculture	4	4	2	4
Riparian	33	49.5	31.5	45.5
Mean	9.6	27.9	7.2	26.4
Standard Deviation	10.5	14.4	10.8	13.5

[a] Those species likely to be seen first, or easily seen and heard.

[b] Those species likely to be heard first, usually seen only after hearing.

[c] Breeding pairs presented in whole or half territories only (IBCC 1970).

Table 3-2. Results of normal distribution test.

	Pairs versus		Pairs versus	
	Observer #1	Observer #2	Visual	Auditory
Probability of > F[a]	0.041	0.025	0.01	0.501

[a]Must be greater than 0.05 for data to be considered normally distributed.

Table 3-3. Results of the Willcoxon 2-Sample Test.

Willcoxon Scores (Rank Sums)

Level	N	Sum of Scores	Expected Under Ho	Std. Dev. Under Ho	Mean Score	Z	Probability[a] of a > Z
Observer #1	14	219	203	21.67	15.6		
Observer #2	14	187	203	21.67	13.4	0.72	0.47
Visual Cue	14	137	203	21.67	9.8		
Auditory Cue	14	269	203	21.67	19.2	-3.02	0.0025

[a]Must be greater than 0.05 for data to be considered normally distributed.

Table 3-4. The 133 avian species recorded on the Guadalupe Mountain Study Area, August and September 1984 and April through June 1985.

Common Name	Scientific Name	Abundance[a]	Status[b]
Eared Grebe	Podiceps nigricollis	U	T
White-faced Ibis	Plegadis chihi	U	T
Canada Goose	Branta canadensis	U	SR
Green-winged Teal	Anas crecca	C	T
Mallard	Anas platyrhynchos	C	SR
Blue-winged Teal	Anas discors	C	T
Cinnamon Teal	Anas cyanoptera	U	T
Northern Shoveler	Anas clypeata	C	T
Gadwall	Anas strepera	C	T
American Wigeon	Anas americana	C	T
Redhead	Aythya americana	C	T
Ring-necked Duck	Aythya collaris	C	T
Lesser Scaup	Aythya affinis	U	T
Hooded Merganser	Lophodytes cucullatus	U	T
Common Merganser	Mergus merganser	C	T
Ruddy Duck	Oxyura jamaicensis	C	T
Turkey Vulture	Cathartes aura	C	SR
Osprey	Pandion haliaetus	U	T
Sharp-shinned Hawk	Accipiter striatus	U	R
Cooper's Hawk	Accipiter cooperii	U	R
Northern Goshawk	Accipter gentilis	U	R
Red-tailed Hawk	Buteo jamaicensis	C	R
Golden Eagle	Aquila chrysaetos	U	R
American Kestrel	Falco sparverius	C	R
Prairie Falcon	Falco mexicanus	U	R
American Coot	Fulica americana	C	T
Semi-palmated Sandpiper	Charadrius semipalmatus	U	T
Killdeer	Charadrius vociferous	C	SR
American Avocet	Recurvirostra americana	C	T
Greater Yellowlegs	Tringa melanoleuca	U	T
Willet	Catoptrophorus semipalmatus	U	T
Spotted Sandpiper	Actitiu macularia	C	SR
Marbled Godwit	Limosa fedoa	U	T
Long-billed Dowitcher	Limnodromus scolopaceus	U	T
Common Snipe	Gallinago gallinago	U	T
Wilson's Phalarope	Phalaropus tricolor	C	T
Ring-billed Gull	Larus delawarensis	C	SR
Rock Dove	Columba livia	C	R
Band-tailed Pigeon	Columba fasciata	U	SR
Mourning Dove	Zeniada macroura	C	SR
Flammulated Owl	Otus flammeolus	U	R
Western Screech Owl	Otus kennicottii	U	R
Great Horned Owl	Bubo virginianus	U	
Burrowing Owl	Athene cunicularia	U	R
Northern Saw-whet Owl	Aegolius acadicus	U	SR
Common Nighthawk	Chordeiles minor	U	SR
Common Poorwill	Phalaenoptilus nuttallii	U	SR
White-throated Swift	Aeronautes saxatalis	A	SR
Broad-tailed Hummingbird	Selasphorus platycercus	C	SR

Table 3-4. (Continued).

Common Name	Scientific Name	Abundance[a]	Status[b]
Belted Kingfisher	Cervle alcyon	U	SR
Lewis' Woodpecker	Melanerpes lewis	U	R
Hairy Woodpecker	Picoides villosus	U	R
Northern Flicker	Colaptes auratus	C	R
Olive-sided Flycatcher	Contopus borealis	U	SR
Western Wood-Peewee	Contopus sordidulus	C	SR
Dusky Flycatcher	Empidonax oberholseri	C	SR
Gray Flycatcher	Empidonax wrightii	U	SR
Western Flycatcher	Empidonax difficilis	U	SR
Say's Phoebe	Savornis saya	U	SR
Ash-throated Flycatcher	Myiarchus cinerascens	U	SR
Eastern Kingbird	Tyrannus tyrannus	U	SR
Horned Lark	Eremophila alpestris	A	R
Tree Swallow	Tachycineta bicolor	C	T
Violet-green Swallow	Tachycineta thalassina	A	SR
Northern Rough-winged Swallow	Stelgidopteryx serripennis	U	T
Cliff Swallow	Riparia riparia	A	SR
Barn Swallow	Hirundo rustica	U	SR
Steller's Jay	Cyanocitta stelleri	C	R
Scrub Jay	Aphelacoma coerulescens	C	R
Pinyon Jay	Gymnorhinus cyanocephalus	C	R
Clark's Nutcracker	Nucifraga columbiana	C	R
Black-billed Magpie	Pica pica	C	R
American Crow	Corvus brachyrhychos	U	R
Common Raven	Corvus corax	U	R
Black-capped Chickadee	Parus atricapillus	U	R
Mountain Chickadee	Parus gambeli	C	R
Plain Titmouse	Parus inornatus	C	R
Common Bushtit	Psaltriparus minimus	U	R
Red-breasted Nuthatch	Sitta canadensis	U	R
White-breasted Nuthatch	Sitta carolinensis	U	R
Pygmy Nuthatch	Sitta pygmae	U	R
Rock Wren	Salpinctes obsoletus	C	SR
Canyon Wren	Catherpes mexicanus	C	SR
House Wren	Troglodytes aedon	U	SR
American Dipper	Cinclus mexicanus	C	R
Ruby-crowned Kinglet	Regulus calendula	U	T
Blue-gray Gnatcatcher	Polioptila caerulea	U	SR
Western Bluebird	Sialia mexicana	C	R
Mountain Bluebird	Sialia currucoides	C	R
Townsend's Solitaire	Myadestes townsendi	U	R
Veery	Catharus ustulatus	R	T
Hermit Thrush	Catharus guttatus	U	SR
American Robin	Turdus migratorius	C	R
Gray Catbird	Dumetella carolinesis	U	SR
Northern Mockingbird	Mimus polyglottos	U	SR
Sage Thrasher	Oreoscoptes montanus	C	SR
Water Pipit	Anthus spinoletta	A	T
European Starling	Sturnus vulgarus	C	R
Solitary Vireo	Vireo solitarius	U	SR
Warbling Vireo	Vireo gilvus	U	SR
Virginia's Warbler	Vermivora virginiae	C	SR

Table 3-4. (Concluded).

Common Name	Scientific Name	Abundance[a]	Status[b]
Yellow Warbler	Dendroica petechia	A	SR
Yellow-rumped Warbler	Dendroica coronata	A	T
Black-throated Gray Warbler	Dendroica nigresens	C	SR
Townsend's Warbler	Dendroica townsendi	U	T
Grace's Warbler	Dendroica graciae	U	SR
Yellow-breasted Chat	Icteria virens	U	SR
Hepatic Tanager	Piranga flava	U	SR
Western Tanager	Piranga ludoviciana	C	SR
Rose-breasted Grosbeak	Pheuctucus ludovicianus	U	T
Black-headed Grosbeak	Pheucticus melanocephalus	R	SR
Blue Grosbeak	Guiraca caerulea	U	SR
Lazuli Bunting	Passerina cyanea	U	SR
Green-tailed Towhee	Pipilo chlorurus	C	SR
Rufous-sided Towhee	Pipilo erythrophthalmus	C	R
Chipping Sparrow	Spizella passerina	C	SR
Brewer's Sparrow	Spizella breweri	C	SR
Vesper Sparrow	Pooecetes gramineus	C	SR
Sage Sparrow	Amphispiza belli	C	SR
Song Sparrow	Melospiza melodia	C	SR
White-crowned Sparrow	Zonotrichia leucophrys	U	WR
Dark-eyed Junco	Junco hymealis	C	R
Red-winged Blackbird	Agelaius phoeniceus	U	SR
Western Meadowlark	Sturnella neglecta	C	R
Brewer's Blackbird	Euphagus cyanocephalus	C	SR
Brown-headed Cowbird	Molothrus ater	C	SR
Pine Grosbeak	Pinicola enucleator	U	R
Cassin's Finch	Carpodacus cassini	A	R
Red Crossbill	Loxia curvirostra	C	R
Lesser Goldfinch	Carduelis psaltria	U	R
Pine Siskin	Carduelis pinus	C	R
American Goldfinch	Carduelis tristis	U	R
Evening Grosbeak	Coccothraustes vespertina	A	R

[a]Abundance Categories

A - species is almost always seen in large numbers.
C - species is usually seen in numbers in suitable habitat.
U - species is not often seen but is not out of range.
R - species is very infrequently seen in the study area or is out of normal range.

[b]Status Categories

R - species is resident in study area year-round.
SR - species is resident only during the summer; often a breeding species.
WR - species is resident only during the winter.
T - species only occurs in study area during periods of spring or fall migration; or a wandering species.

Sagebrush/Grassland Habitat Site

There are 6,250 acres of Sagebrush/Grassland Habitat within the GMSA. This habitat site (33.3%) and the Pinyon/Juniper Woodland (33.2%) each occupy about one third of the study area. Twenty two species of birds were recorded at least once on the Sagebrush/Grassland Grid (Table 3-5). Twelve species were classified as visitors, four as partial breeders, and six as breeding species. The majority of breeding pairs (89%) on the grid were of the following species; Brewer's Sparrow, Vesper Sparrow, or Sage Sparrow. An estimated 18 breeding pairs of birds occurred on this grid. This is equal to a breeding density of 200 pairs/km^2 and an estimated 5,006 breeding pairs within the GMSA.

The Sagebrush/Grassland Grid had the second lowest breeding bird density among the grids, the lowest number of breeding species, and the lowest diversity index of the GMSA grids (Table 3-6). Its diversity index (1.43) was well below those of the other five native vegetation grids, which ranged from 2.34 to 2.88. However, because it was the largest habitat site in total area within the GMSA, the estimated breeding population for the Sagebrush/Grassland Habitat Site (5,006 pairs) was the second highest on the study area.

The results of this study are comparable with previous studies in sagebrush habitats in Wyoming and Utah and rabbitbrush grassland in western New Mexico (Table 3-7). The estimated population of 200 breeding pairs/km^2 in this study was the second highest density estimate among the five studies. The GMSA grid, which was 67% chained and 33% undisturbed, had a diversity index of 1.43. This index is slightly higher than the index for one year of a two year study on undisturbed sagebrush in Utah (1.29) and noticeably higher than the indices for both years in chained sagebrush in Utah (1.00, 1.08). It is lower than the indices for undisturbed sagebrush in Wyoming (1.77) and the second year in undisturbed sagebrush in Utah (1.89). The rabbitbrush grassland in western New Mexico, similar in structure to the Sagebrush/Grassland Habitat Site, also had similar (1.33, 1.45) diversity indices. This study reported the second highest number of breeding species (6) and total species observed (22) (Table 3-7).

Table 3-5. Estimated breeding bird pairs on the Sagebrush/Grassland Grid.

Species	Observer # 1	Observer # 2	Avg	No./km^2[a] (range)	Total on GMSA (range)[b]
American Kestrel	+	+	+	0	0
Mourning Dove	V	V	0	0	0
Common Nighthawk	V	V	0	0	0
White-throated Swift	V	V	0	0	0
Broad-tailed Hummingbird	2	+	1	11 (0-22)	278 (0-278)
Horned Lark	V	V	0	0	0
Violet-green Swallow	V	V	0	0	0
Barn Swallow	V	V	0	0	0
Pinyon Jay	+	+	+	0	0
Common Raven	V	V	0	0	0
Western Bluebird	V	V	0	0	0
Mountain Bluebird	.5	+	.5	6 (0-6)	139 (0-139)
American Robin	V	V	0	0	0
Sage Thrasher	V	V	0	0	0
Green-tailed Towhee	.5	+	.5	6 (0-6)	139 (0-139)
Chipping Sparrow	+	+	+	0	0
Brewer's Sparrow	4	4.5	4.5	50 (45-50)	1252 (1112-1252)
Vesper Sparrow	6.5	5	5.5	61 (55-72)	1530 (1390-1808)
Sage Sparrow	6	6	6	67 (67)	1669 (1669)
Red-winged Blackbird	V	V	0	0	0
Western Meadowlark	+	+	+	0	0
Brewer's Blackbird	V	V	0	0	0
Breeding Pairs	19.5	15.5	18	200(172-216)	5006(4311-5423)

[a] Range based on estimates by individual observers.

[b] Estimated total breeding pairs for GMSA based on 6,250 acres of available habitat.

V - Visitor to the grid.

\+ - Breeding species with part of a territory on the grid.

Table 3-6. Comparisons of breeding densities, number of breeding species, species diversities, and total estimated GMSA populations in the seven habitat sites.

Habitat Site	Estimated Breeding pairs/km	Rank	Number of Breeding Species	Rank	Diversity Index	Rank	Estimated Study Area Breeding Population (pairs)[a]
Sagebrush/ Grassland	200 (172-216)	6	6	7	1.43	7	5,006 (4,311-5,423)
Pinyon/Juniper Woodland	366 (316-400)	5	19	3	2.55	4	9,149 (7,898-9,978)
Upland Forest	500 (446-518)	2	21	1	2.79	2	3,139 (2,813-3,375)
Wooded Canyon Benches	378 (366-389)	4	20	2	2.88	1	2,602 (2,541-2,695)
Canyon Slopes	457 (444-475)	3	16	5	2.67	3	2,745 (2,673-2,861)
Agricultural Lands	88 (78-104)	7	8	6	1.95	6	147 (127-169)
Riparian	723 (701-751)	1	19	3	2.34	5	260 (254-272)
Total							23,048 (20,613-24,654)
Average density[b]	307						

[a]Includes only those species with >0.5 territories on the grid.

[b]Average density = 23,048 breeding pairs/758 km

Table 3-7. A comparison of the 1985 GMSA census results on the Sagebrush-Grassland Habitat Site with census results in similar habitats in the western United States.

		Sagebrush			Rabbitbrush
	This study	Wyoming[a]	Utah[b] Undisturbed	Chained	New Mexico[c]
Grid Size (hectares)	9.0	8.1	16.2	16.2	16.2
(acres)	22.5	20.0	40.0	40.0	40.0
Breeding pairs/km^2 (range)[d]	200 (172-216)	222 -	104 (100-108)	85 (80-90)	122 (90-154)
Total Breeding Species[e] (range)	9	7	5 (5,5)	3 (4,5)	5 (5,6)
Breeding Species[f] (range)	6	7	4 (4,4)	3 (3,3)	5 (5,5)
Breeding Species in common with this study[e]	-	3	3	2	3
All species observed[g] (range)	22	7+[h]	15 (15, ?)	13 (13, ?)	22 (18.21)
Species in common with this study[g]	-	5+[h]	10	7	16
Diversity Index[i] (range)	1.43	1.77	1.29,1.86	1.00,1.08	1.33,1.45

[a] Todd (1974); counts conducted in 1974.

[b] Castrale and Parker (1981); counts conducted in 1979 and 1980.

[c] McCallum and Price (1978), McCallum and Leibman (1980); counts conducted in 1977 and 1979.

[d] ranges given for studies with multiple estimates (this study) or multiple years of data.

[e] Includes species with partial (< .5) territories on the grid.

[f] Includes only species with ≥ .5 territories on the grid.

[g] Includes breeding species, partial breeders, and visitors.

[h] Visitors not given.

[i] Calculated using breeding species (≥ .5 territories) only.

? - Visitors given for only one year.

Pinyon/Juniper Woodland Habitat Site

The Pinyon/Juniper Woodland Habitat within the GMSA contains 6,230 acres. Thirty five species of birds were recorded on the Pinyon/Juniper Woodland Grid (Table 3-8). Eleven of these species were classified as visitors, five as partial breeders, and 19 as breeding species. Black-throated Gray Warblers and Plain Titmice were most numerous on the grid, while Mountain Chickadees and Brown-headed Cowbirds were also common. An estimated 33 breeding pairs of birds occurred on this grid, which extrapolates to 366 breeding pairs/km^2 and an estimated 9,149 breeding pairs within the study area.

The Pinyon/Juniper Woodland Grid ranked fifth in breeding pair density (366/km^2) and third in number of breeding species (19) among the GMSA grids (Table 3-6). Its diversity index (2.55) ranked fourth, though it was only 11.5% less than the highest index of 2.88 (Wooded Canyon Benches). Because the Pinyon/Juniper Woodland Habitat Site was one of the largest habitat sites on the GMSA and had a moderate density of breeding pairs, it contributed the highest number of breeding pairs (9,149) to the total GMSA avian population.

The estimated breeding bird density (366/km^2) in this habitat was second highest among five reported studies in similar habitats (Table 3-9). All four of the other studies cited also presented the results of a single year's survey. The GMSA grid had noticeably more breeding species (19) than the other four grids (range: 9-13), though total species observed (35) was comparable to the total species reported in an eastern California woodland (32). Twenty two species were observed on a grid in western New Mexico, while two other studies, one in northwestern Colorado and one in southeastern California, did not report grid visitors. The GMSA diversity index (2.55) was also noticeably higher than that of the other four studies, which averaged 2.00 (Table 3-9).

Upland Forest Habitat Site

There are 1,570 acres (8.4%) of Upland Forest Habitat within the GMSA. Thirty six avian species were recorded on the Upland Forest grid (Table 3-10).

Table 3-8. Estimated breeding bird pairs on the Pinyon/Juniper Woodland Grid.

Species	Observer # 1	Observer # 2	Avg	No./km^2[a] (range)	Total on GMSA (range)[b]
Mourning Dove	1	1	1	11 (11)	277 (277)
Common Nighthawk	V	V	0	0	0
White-throated Swift	V	V	0	0	0
Broad-tailed Hummingbird	2	+	1	11 (0-22)	277 (0-554)
Hairy Woodpecker	.5	+	.5	6 (0-6)	139 (0-139)
Northern Flicker	.5	+	.5	6 (0-6)	139 (0-139)
Gray Flycatcher	1	.5	.5	6 (6-11)	139 (139-277)
Ash-throated Flycatcher	.5	.5	.5	6 (6)	139 (139)
Violet-green Swallow	1	1	1	11 (11)	277 (277)
Steller's Jay	V	V	0	0	0
Scrub Jay	+	+	+	0	0
Pinyon Jay	+	+	+	0	0
Clark's Nutcracker	+	+	+	0	0
American Crow	V	V	0	0	0
Mountain Chickadee	3	3	3	33 (33)	832 (832)
Plain Titmouse	6	5.5	5.5	61 (61-67)	1525 (1525-1662)
Common Bushtit	V	V	0	0	0
Red-breasted Nuthatch	1	+	.5	6 (0-11)	139 (0-277)
White-breasted Nuthatch	1	1	1	11 (11)	277 (277)
Pygmy Nuthatch	1.5	1	1.5	17 (11-17)	416 (277-416)
Ruby-crowned Kinglet	V	V	0	0	0
Western Bluebird	1	1	1	11 (11)	277 (277)
Townsend's Solitaire	V	V	0	0	0
American Robin	+	+	+	0	0
Solitary Vireo	.5	.5	.5	6 (6)	139 (139)
Yellow-rumped Warbler	V	V	0	0	0
Black-throated Gray Warbler	6.5	6	6.5	72 (67-72)	1802 (1662-1802)
Townsend's Warbler	V	V	0	0	0
Rufous-sided Towhee	.5	.5	.5	6 (6)	139 (139)
Chipping Sparrow	2	2	2	22 (22)	554 (554)
Dark-eyed Junco	2.5	2	2.5	28 (22-28)	693 (554-693)
Brown-headed Cowbird	4	3	3.5	39 (33-44)	970 (831-1108)
Cassin's Finch	V	V	0	0	0
Red Crossbill	+	+	+	0	0
Pine Siskin	V	V	0	0	0
Breeding Pairs	36	28.5	33	366 (316-400)	9149 (7899-9978)

[a] Range based on estimates by individual observers.

[b] Estimated total breeding pairs for GMSA based on 6,230 acres of available habitat.

V - Visitor to grid; too few territorial registrations.

\+ - Breeding species with part (but < 0.5) of territory on grid.

Table 3-9. A comparison of the 1985 census results on the Pinyon/Juniper Habitat Site with census results in similar habitats in the western United States.

	This study	SE Calif.[a]	E Calif.[b]	NW Colorado[c]	W New Mexico[d]
Grid Size (hectares)	9.0	9.0	27.8	12.0	3.9
(acres)	22.5	22.5	69.5	30.0	9.8
Breeding pairs/km^2 (range)[e]	366 (316-400)	100	196	290	475
Total Breeding Species[f]	24	13	13	10	9
Breeding Species[g]	19	7	13	10	8
Total Breeding Species[f] in common with this study	-	3	8	7	5
All species observed[h]	35	13+[i]	32	10+[i]	22
Species in common with this study[h]	-	6	16	7	14
Diversity Index[j]	2.55	1.91	2.00	2.10	2.00

[a]Cardiff (1979); counts were conducted in 1978.

[b]Woodman (1979); counts were conducted in 1978.

[c]O'Meara, et al. (1981); counts were conducted in 1977.

[d]McCallum (1979); counts were conducted in 1979.

[e]range given for multiple estimates (this study).

[f]Includes species with partial (< .5) territories on the grid.

[g]Includes only species with $\geq$ .5 territories on the grid.

[h]Includes breeding species, partial breeders, and visitors.

[i]Visitors not given.

[j]Calculated using breeding species (0.5 territories or more) only.

Table 3-10. Estimated breeding bird pairs on the Upland Forest Grid.

Species	Observer # 1	Observer # 2	Avg	No./ km^2 (range)[a]	Total on GMSA (range)[b]
Mourning Dove	3.5	3	3.5	42 (36-42)	262 (225-262)
Northern Saw-whet Owl	V	V	0	0	0
Broad-tailed Hummingbird	2.5	+	1.5	18 (0-30)	112 (0-187)
Hairy Woodpecker	1	1	1	12 (12)	75 (75)
Northern Flicker	1	1	1	12 (12)	75 (75)
Olive-sided Flycatcher	+	+	+	0	0
Dusky Flycatcher	1.5	1.5	1.5	18 (18)	112 (112)
Violet-green Swallow	1.5	1	1.5	18 (12-18)	112 (75-112)
Steller's Jay	1	1	1	12 (12)	75 (75)
Pinyon Jay	V	V	0	0	0
Clark's Nutcracker	+	+	+	0	0
Black-billed Magpie	V	V	0	0	0
Common Raven	V	V	0	0	0
Mountain Chickadee	3	3	3	36 (36)	224 (224)
Common Bushtit	+	+	+	0	0
Red-breasted Nuthatch	1	1	1	12 (12)	75 (75)
White-breasted Nuthatch	1	+	.5	6 (0-12)	37 (0-75)
Pygmy Nuthatch	3	3	3	36 (36)	224 (224)
House Wren	1	1	1	12 (12)	75 (75)
Western Bluebird	.5	+	.5	6 (0-6)	37 (0-37)
Townsend's Solitaire	1.5	1.5	1.5	18 (18)	112 (112)
American Robin	+	+	+	0	0
Solitary Vireo	1	1	1	12 (12)	75 (75)
Virginia's Warbler	3	4	3.5	42 (36-48)	262 (225-300)
Yellow-rumped Warbler	V	V	0	0	0
Western Tanager	1.5	1	1.5	18 (12-18)	112 (75-112)
Black-headed Grosbeak	.5	.5	.5	6 (6)	37 (37)
Rufous-sided Towhee	7	6	6.5	77 (71-83)	486 (450-525)
Chipping Sparrow	V	V	0	0	0
Dark-eyed Junco	4.5	4	4.5	54 (48-54)	336 (300-336)
Brown-headed Cowbird	3	3	3	36 (36)	224 (224)
Pine Grosbeak	V	V	0	0	0
Cassin's Finch	V	V	0	0	0
Red Crossbill	V	V	0	0	0
Pine Siskin	V	V	0	0	0
Evening Grosbeak	V	V	0	0	0
	43.5	37.5	42	500 (446-518)	3139 (2813-3263)

[a] Ranges based on estimates by individual observers.

[b] Estimated total breeding pairs for GMSA based on 1,570 acres of available habitat.

V - Visitor to grid; too few registrations or one or no territorial registrations.

+ - Breeding species with part (but < 0.5) of territory on grid.

Eleven of these species were classified as visitors, four as partial breeders, and 21 as breeding species. Rufous-sided Towhees were the most numerous breeding species, while Dark-eyed Juncos, Mourning Doves, and Virginia's Warblers were also common. An estimated 42 breeding pairs of birds occurred on this grid, which converts to 500 breeding pairs/km^2 and an estimated 3,139 breeding pairs within the GMSA.

The Upland Forest Grid had the second highest density of breeding pairs (500/km^2) and the second highest diversity index (2.79) of the GMSA grids (Table 3-6). It also had the greatest number of breeding species (21). Though only 8.4% of the total area, it contributed 13.6% (3,139 pairs) of the estimated breeding pairs on the GMSA. The 3,139 breeding pairs was the third highest total, ranking the Upland Forest Habitat Site behind the Sagebrush/Grassland and Pinyon/Juniper Woodland Habitat Sites which have significantly more acreage.

As discussed in Section 2.0, this habitat site has characteristics of both the Pinyon/Juniper/Big Sagebrush Association and the Ponderosa Pine/Douglas Fir Association (USDA/SCS, 1978). Because of this vegetative mix in the Upland Forest Habitat Site, there is a paucity of comparable spot mapping studies. The most suitable comparison is between data from this grid and data from an isolated low elevation Ponderosa Pine/Douglas Fir stand in Colorado (Traynor 1983) and from logged and unaltered stands of the same species in Arizona (Franzreb 1977) (Table 3-11). Ponderosa Pine was the dominant tree in the Colorado study plot; Douglas Fir was dominant in both Arizona grids. The Upland Forest Grid overstory is a mixture of Douglas Fir and Ponderosa Pine (Section 2.0). The avian population in the Upland Forest Grid reflects this mixed canopy overstory; it had twice the number of total breeding species of the Colorado grid, but about half the number of total breeding species of the two Arizona grids. Seven of 12 (58%) Colorado breeding species were also breeders in the GMSA, while 17 of 21 (81%) GMSA species also bred in the logged Arizona grid and 19 of 21 (90%) GMSA species were present in the unaltered Arizona grid. Finally, the Upland Forest Grid's diversity index (2.79) was noticebly higher than that of the Colorado grid (2.25), and within the range of both Arizona grids (2.69-3.15; 2.76-3.19). In only one respect did the Upland Forest Grid vary from its mid-range position;

Table 3-11. A comparison of the 1985 GMSA census results on the Upland Forest Habitat Site with census results in similar habitats in Colorado and Arizona.

	This study	Colorado[a]	Arizona[b] Logged	Arizona[b] Unaltered
Grid Size (hectares)	8.4	7.5	15.5	15.5
(acres)	21.0	18.6	36.8	36.8
Breeding pairs/km^2 (range)[c]	500 (446-518)	545	814 (680-948)	936 (791-1082)
Total Breeding Species[d] (range)	24	12	41 (30,36)	37 (28,34)
Breeding Species[e] (range)	21	12	41 (30,40)	37 (28,34)
Breeding Species in common with this study[d]	-	7	19	17
All species observed[f] (range)	36	21	45 (32,41)	42 (30,39)
Species in common with this study[f]	-	10	22	21
Diversity Index[g] (range)	2.79	2.25	2.69,3.15	2.76,3.19

[a] Traynor (1983); counts conducted in 1982.

[b] Franzreb (1977); counts conducted in 1973 and 1974.

[c] Ranges given for studies with multiple estimates (this study) or multiple years of data.

[d] Includes species with partial (< 0.5) territories on the grid.

[e] Includes species with $\geq$ 0.5 territories on the grid.

[f] Includes breeding species, partial breeders, and visitors.

[g] Calculated using breeding species ($\geq$ 0.5 territories) only; on the Arizona study, diversity indices are given for each year of the study.

it had the lowest density (500 pairs/km^2), though only slightly lower than that calculated for the Colorado grid (545 pairs/km^2). Breeding densities on both logged (814 pairs/km^2; 2 year average) and unaltered Arizona grids (936 pairs/km^2 ; 2 year average) were noticeably higher than the density on the GMSA.

Wooded Canyon Benches Habitat Site

This habitat site contributes 1,720 acres (9.2%) of the total area on the GMSA. Thirty three species occurred on the Wooded Canyon Benches Grid (Table 3-12); a nine hectare (22.5 acre) grid. Twelve species were only visitors, one was a partial breeder, and 20 were breeding species. All 20 breeding species occurred in low (1-3.5 pairs on the grid) densities, though Chipping Sparrows, Violet-green Swallows, Pygmy Nuthatches, and Rock Wrens were the most numerous breeding species. The estimated densities are 35 breeding pairs on the grid, 378 pairs/km^2, and 2,602 pairs within the study area.

The Wooded Canyon Benches Habitat Site had the highest diversity index (2.88) of all the GMSA grids, though five other grids had indices within 20% of this grid (Table 3-6). Many species with approximately equal numbers result in the highest diversity indices (MacArthur and MacArthur 1961); this was the case with the Wooded Canyon Benches avian population (Table 3-12). This grid ranked fourth in density (378 breeding pairs/km^2), the GMSA average was 307 pairs/km^2. However, it ranked second in number of breeding species. Thus its avifauna can be summarized as diverse, but only occurring in moderate numbers.

Census data from truly comparable habitats could not be found in the literature.

Canyon Slopes Habitat Site

There are 1,690 acres (9.0%) on the study area that are part of the Canyon Slopes Habitat Site. Thirty eight species were recorded on the Canyon Slopes Grid (Table 3-13), an eight hectare (20 acre) grid. Fourteen species were visitors, eight species had territories partially on the grid, and 16

Table 3-12. Estimated breeding bird pairs on the Wooded Canyon Benches Grid.

Species	Observer # 1	Observer # 2	Avg	No./ km^2 (range)[a]	Total on GMSA (range)[b]
Turkey Vulture	V	V	0	0	0
Cooper's Hawk	V	V	0	0	0
White-throated Swift	V	V	0	0	0
Broad-tailed Hummingbird	2	+	1	11 (0-22)	77 (0-154)
Hairy Woodpecker	1	1	1	11 (11)	77 (77)
Northern Flicker	1	1	1	11 (11)	77 (77)
Dusky Flycatcher	1	1	1	11 (11)	77 (77)
Violet-green Swallow	3	3	3	33 (33)	230 (230)
Steller's Jay	V	V	0	0	0
Clark's Nutcracker	+	+	+	0	0
Common Raven	V	V	0	0	0
Mountain Chickadee	2	2	2	22 (22)	153 (153)
Plain Titmouse	2	2	2	22 (22)	153 (153)
Common Bushtit	1	1	1	11 (11)	77 (77)
Red-breasted Nuthatch	V	V	0	0	0
Pygmy Nuthatch	3	3	3	33 (33)	230 (230)
Rock Wren	2.5	3	2.5	28 (28-33)	191 (191-230)
Canyon Wren	1	2	1.5	17 (11-22)	115 (77-154)
House Wren	V	V	0	0	0
Ruby-crowned Kinglet	V	V	0	0	0
Western Bluebird	V	V	0	0	0
Townsend's Solitaire	1	1	1	11 (11)	77 (77)
American Robin	2	2	2	22 (22)	153 (153)
Solitary Vireo	1	1	1	11 (11)	77 (77)
Black-throated Gray Warbler	V	V	0	0	0
Virginia's Warbler	3	3	3	33 (33)	230 (230)
Western Tanager	1	1	1	11 (11)	77 (77)
Green-tailed Towhee	1	1	1	11 (11)	77 (77)
Rufous-sided Towhee	1.5	1	1.5	17 (11-17)	115 (77-115)
Chipping Sparrow	4	3	3.5	39 (33-44)	268 (230-308)
Brown-headed Cowbird	1	1	1	11 (11)	77 (77)
Cassin's Finch	V	V	0	0	0
Red Crossbill	V	V	0	0	0
Breeding Pairs	35	33	34	378 (366-389)	2602 (2541-2695)

[a] Range based on estimates by individual observers.

[b] Estimated total breeding pairs for GMSA based on 1,720 acres of available habitat.

V - Visitor to grid; too few registrations or one or no territorial registrations.

+ - Breeding species with part (but < 0.5) of territory on grid.

Table 3-13. Estimated breeding bird pairs on the Canyon Slopes Grid.

Species	Observer # 1	Observer # 2	Avg	No./ km^2 (range)[a]	Total on GMSA (range)[b]
Canada Goose	V	V	0	0	0
Turkey Vulture	V	V	0	0	0
Mourning Dove	2	2	2	25 (25)	150 (150)
Great Horned Owl	V	V	0	0	0
White-throated Swift	V	V	0	0	0
Broad-tailed Hummingbird	3	1	2	25 (13-36)	150 (75-225)
Northern Flicker	+	+	+	0	0
Western Wood-Pewee	4	4	4	50 (50)	301 (301)
Dusky Flycatcher	3	3	3	38 (38)	226 (226)
Say's Phoebe	1	1	1	13 (13)	75 (75)
Violet-green Swallow	+	+	+	0	0
Pinyon Jay	+	+	+	0	0
Clark's Nutcracker	+	+	+	0	0
Black-billed Magpie	V	V	0	0	0
Common Raven	+	+	+	0	0
Mountain Chickadee	V	V	0	0	0
Plain Titmouse	V	V	0	0	0
Common Bushtit	V	V	0	0	0
Rock Wren	2.5	3	2.5	31 (31-38)	188 (188-225)
House Wren	3	3	3	38 (38)	226 (226)
Ruby-crowned Kinglet	V	V	0	0	0
Western Bluebird	V	V	0	0	0
Mountain Bluebird	V	V	0	0	0
Townsend's Solitaire	1	1	1	13 (13)	75 (75)
American Robin	2	2	2	25 (25)	150 (150)
Solitary Vireo	1	1	1	13 (13)	75 (75)
Warbling Vireo	+	+	+	0	0
Virginia's Warbler	2	2	2	25 (25)	150 (150)
Yellow Warbler	2.5	2.5	2.5	31 (31)	188 (188)
Yellow-breasted Chat	1	1	1	13 (13)	75 (75)
Western Tanager	+	+	+	0	0
Green-tailed Towhee	2	2	2	25 (25)	150 (150)
Rufous-sided Towhee	5	4	4.5	56 (50-63)	338 (300-375)
Dark-eyed Junco	+	V	+	0	0
Brewer's Blackbird	V	V	0	0	0
Brown-headed Cowbird	3	3	3	38 (38)	226 (226)
Cassin's Finch	V	V	0	0	0
Red Crossbill	V	V	0	0	0
	38	35.5	36.5	457 (444-475)	2745 (2673-2861)

[a] Range based on estimates of individual observers.

[b] Estimated total breeding pairs for GMSA based on 1,690 acres of available habitat.

V - Visitor to grid; too few territorial registrations.

+ - Breeding species with part (but < 0.5) of territory on grid.

were breeding species. Rufous-sided Towhees and Western Wood-Pewees were most common, followed by House Wrens and Dusky Flycatchers. Breeding pair density was estimated as 36.5 pairs on the grid, 457 pairs/km^2 and 2,745 pairs for the Canyon Slopes Habitat Site within the GMSA.

The Canyon Slopes Grid ranked third in density (457 breeding pairs/km^2), third in diversity index (2.67), and fifth in number of breeding species (16) (Table 3-6) . Since the ranges of the density estimates by the two observers for this habitat site and the Upland Forest Habitat Site (second in density) overlapped, their breeding populations appear quite comparable in size. Likewise, the diversity index was within 8% of the highest for the GMSA, Wooded Canyon Benches (2.88), which is not a discernable difference.

Density estimates for several species recorded within this habitat site are probably artificially high due to the grid location. This habitat site is restricted to narrow, steep canyon slopes. To establish a grid of appropriate size and accessibility, the western border of the grid was the shoreline of the Rio Grande. This shoreline contains more and taller trees than the rest of the grid. This vegetation and its close proximity to the river concentrated birds within the grid, especially the Yellow Warbler and the Yellow-breasted Chat. Since these species were restricted to the thin belt of riparian vegetation, extrapolating their grid populations to the entire 1,690 acres of the Canyon Slopes Habitat Site, much of which is unsuitable habitat for them, probably overestmates their GMSA populations (Table 3-13).

Townsend's Solitaires were recorded as breeding species in this and the preceeding two habitat sites. Most individuals recorded exhibiting breeding behavior were documented in April and early May; only on the Wooded Canyon Benches grid were Townsend's Solitaires seen after early May. We assume that most Townsend's Solitaires moved to higher elevations, i.e., the nearby Sangre de Cristo Range, to nest. Although GMSA estimates do not reflect true breeding densities for this species on the study area, they do reflect the availability of this species to Peregrine Falcons during April and early May.

Census data from truly comparable habitats could not be found in the literature.

Agricultural Lands Habitat Site

Only 420 acres (2.2%) of the GMSA was in the Agricultural Lands Habitat Site. There were 24 species of birds recorded on this grid; 16 species were visitors and the remaining eight were breeding species. Western Meadowlarks were the most obvious and numerous grid residents. There were an estimated 7 breeding pairs on the grid, 88 pairs/km^2, and 147 pairs for the habitat site within the GMSA (Table 3-14).

The Agricultural Lands Habitat Grid had the lowest breeding density (88 pairs/km^2) and contributed the smallest number of birds (147 pairs) to the overall breeding bird population of the GMSA (Table 3-6). It was also second lowest in number of breeding species (8) and in diversity index (1.95). Its diversity index fell midway between those of the the five habitats with the highest indices (2.34-2.88) and the habitat with the lowest index (Sagebrush/Grassland, 1.43).

This habitat site was vegetatively similar to two grids in alfalfa fields in North Dakota (Fleckenstein and Mack 1981). One of these fields was an alfalfa monoculture; the other contained clumps of shrubs and rockpiles. The grid with shrub islands had a higher density of breeding birds and a higher diversity index than the alfalfa monoculture (Table 3-15). The GMSA grid had scattered trees and fence rows and was close to a stand of Pinyon/Juniper Woodland and an abandoned building. Not surprisingly, it had higher values than the alfalfa monoculture for all paramaters (Table 3-15), but lower values than the more diverse alfalfa hayland with shrub clumps. However, the overlap in breeding species and all species observed between the GMSA grid and the North Dakota grids was low. North Dakota has a noticeably different avifauna, with strong northern and eastern influences, from that of nothern New Mexico. No comparable study sites, however, could be found nearer to New Mexico and the overall comparisons were deemed appropriate.

Riparian Habitat Site

This habitat site has the lowest acreage (90 acres) on the GMSA. There were 37 species recorded on the Riparian grid; 16 species were visitors, two

Table 3-14. Estimated breeding bird pairs on the Agricultural Lands Grid.

Species	Observer # 1	Observer # 2	Avg	No./ km^2 (range)[a]	Total on GMSA (range)[b]
American Kestrel	V	V	0	0	0
Rock Dove	V	V	0	0	0
Band-tailed Pigeon	V	V	0	0	0
Mourning Dove	V	V	0	0	0
Broad-tailed Hummingbird	1	+	.5	6 (0-13)	11 (0-21)
Barn Swallow	.5	.5	.5	6 (6)	11 (11)
Black-billed Magpie	1	1	1	13 (13)	21 (21)
Common Raven	V	V	0	0	0
American Crow	V	V	0	0	0
Black-capped Chickadee	V	V	0	0	0
Western Bluebird	V	V	0	0	0
American Robin	V	V	0	0	0
Water Pipit	V	V	0	0	0
European Starling	.5	.5	.5	6 (6)	11 (11)
Yellow-rumped Warbler	V	V	0	0	0
Chipping Sparrow	1	1	1	13 (13)	21 (21)
Vesper Sparrow	1	1	1	13 (13)	21 (21)
Song Sparrow	V	V	0	0	0
Red-winged Blackbird	V	V	0	0	0
Western Meadowlark	2	2	2	25 (25)	42 (42)
Brewer's Blackbird	1	+	.5	6 (0-13)	11 (0-21)
Brown-headed Cowbird	V	V	0	0	0
Pine Siskin	V	V	0	0	0
American Goldfinch	V	V	0	0	0
Breeding Pairs	8	6	7	88 (78-104)	147 (127-169)

[a] Range based on estimates by individual observers.

[b] Estimated total breeding pairs for GMSA based on 420 acres of available habitat.

V - Visitor to grid; too few territorial registrations or observations.

+ - Breeding species with part (but < 0.5) of territory on grid.

Table 3-15. A comparison of the 1985 census results on the Agricultural Lands Habitat Site with census results in similar habitats North Dakota.

	This Study	North Dakota[a] Alfalfa Hayland	North Dakota[a] Alfalfa Hayland with shrub clumps
Grid Size (hectares)	8.0	16.2	10.8
(acres)	20.0	40.0	26.7
Breeding pairs/km^2 (range)[b]	88 (78-104)	56	218
Total Breeding Species[c]	8	4	12
Breeding Species[d]	8	4	12
Breeding Species in common with this study[c]	-	1	2
All species observed[e]	23	15	31
Species in common with this study[e]	-	6	8
Diversity Index[f]	1.95	1.31	2.18

[a]Fleckenstein and Mack (1981); counts conducted in 1980.

[b]Ranges given for the multiple estimates (this study).

[c]Includes species with partial (< 0.5) territories on the grid.

[d]Includes species with $\geq$ 0.5 territories on the grid.

[e]Includes breeding species, partial breeders, and visitors.

[f]Calculated using breeding species ($\geq$ 0.5 territories) only.

were partial breeders, and 19 were breeding species (Table 3-16). Cliff Swallows and Yellow Warblers were by far the most abundant breeding species on the grid, while Song Sparrows, Western Wood-Pewees, and American Robins were also common. Density estimates are 79.5 breeding pairs on the grid, 723 pairs/km^2, and 260 pairs for the habitat within the GMSA.

The Riparian Habitat Site had the highest density of breeding pairs (723/km^2) on the GMSA. Though it had the highest density, the small amount of riparian habitat supported an estimated population of only 260 breeding pairs, 1.1% of the GMSA total (Table 3-5). The Riparian Grid also had the third highest number of breeding species (19), and the fifth highest diversity index (2.34). Diversity indices are highest when all species have approximately equal numbers (MacArthur and MacArthur 1961). Conversely, when a few species are much higher (or lower) than the others, it decreases the diversity index. This is the effect that high breeding populations of Yellow Warblers and Cliff Swallows on the Riparian Grid had upon its diversity index. Still, it was within 20% of the highest calculated diversity index, 2.88 on the Wooded Canyon Benches Grid, on the GMSA.

The population density (723 pairs/km^2) on the Riparian Grid was comparable to 873 pairs/km^2 in a mixed mesophytic canyon bottom in western New Mexico (Price and McCallum 1978, McCallum 1979). However, this two year study reported twice the number of breeding species and 1.7 times the number of total species observed. Their diversity indices, especially in the second year of the study (3.15), were noticeably higher than that of the GMSA riparian grid (2.34) (Table 3-17). It appears from the grid description that a significant amount of Ponderosa Pine forest was part of the mesophytic grid (Sheppard 1959), providing more habitat variety and thereby significantly increasing the number of breeding species, though not the number of breeding pairs. This premise was confirmed by McCallum (pers. comm. 1985).

Mill Tailings Habitat Site

An additional 800 acres (4.3%) of the study area were characterized as mill tailings (Appendix A). This area included open water, exposed wet and dry tailings, dams, dikes, roads, and interspersed areas of native vegetation,

Table 3-16. Estimated breeding bird pairs on the Riparian Grid.

Species	Observer # 1	Observer # 2	Avg	No./ km^2 (range)[a]	Total on GMSA (range)[b]
Common Merganser	V	V	0	0	0
Turkey Vulture	V	V	0	0	0
Osprey	V	V	0	0	0
White-throated Swift	V	V	0	0	0
Broad-tailed Hummingbird	3	+	1.5	14 (0-27)	5 (0-10)
Western Wood-Pewee	4.5	5	4.5	41 (41-46)	15 (15-16)
Empidonax sp.	3	2	2.5	23 (18-27)	8 (7-10)
Say's Phoebe	V	V	0	0	0
Violet-green Swallow	+	+	+	0	0
Cliff Swallow	20	20	20	182 (182)	66 (66)
Steller's Jay	.5	1	.5	5 (5-9)	2 (2-3)
Clark's Nutcracker	V	V	0	0	0
Black-billed Magpie	V	V	0	0	0
Common Raven	V	V	0	0	0
Black-capped Chickadee	1	1	1	9 (9)	3 (3)
Rock Wren	+	+	+	0	0
House Wren	2	1	1.5	14 (9-18)	5 (3-7)
American Dipper	3.5	4.5	4	36 (32-41)	13 (12-15)
Ruby-crowned Kinglet	V	V	0	0	0
Townsend's Solitaire	1.5	1	1.5	14 (9-14)	5 (3-5)
Veery	V	V	0	0	0
American Robin	5.5	4	4.5	41 (36-50)	15 (13-18)
Gray Catbird	V	V	0	0	0
Warbling Vireo	1	1	1	9 (9)	3 (3)
Virginia's Warbler	.5	+	.5	5 (0-5)	2 (0-2)
Yellow Warbler	18	18.5	18.5	168 (164-168)	61 (59-61)
Yellow-breasted Chat	2	2	2	18 (18)	7 (7)
Western Tanager	2	1	1.5	14 (9-18)	5 (3-7)
Blue Grosbeak	V	V	0	0	0
Lazuli Bunting	V	V	0	0	0
Green-tailed Towhee	1	+	.5	5 (0-9)	2 (0-2)
Song Sparrow	5.5	8	6.5	59 (50-73)	21 (18-26)
White-crowned Sparrow	V	V	0	0	0
Dark-eyed Junco	2	1	1.5	14 (9-18)	5 (3-7)
Brewer's Blackbird	6	6	6	55 (55)	20 (20)
Brown-headed Cowbird	V	V	0	0	0
Cassin's Finch	V	V	0	0	0
Breeding Pairs	82.5	77	79.5	723 (701-751)	260 (254-272)

[a]Range based on estimates of individual observers.

[b]Estimated total breeding pairs for GMSA based on 90 acres of available habitat.

V - Visitor to grid; too few territorial registrations.

+ - Breeding species with part (but < 0.5) of territory on grid.

Table 3-17. A comparison of the 1985 census results on the Riparian Habitat Site with census results from a similar habitat in western New Mexico.

	This Study	Western New Mexico Mixed Mesophytic Canyon Bottom[a]
Grid Size (hectares)	11.3	12.2
(acres)	28.3	30.1
Breeding pairs/km^2 (range)[b]	726 (701-751)	873 (861-885)
Total Breeding Species[c] (range)	21	41 (35,33)
Breeding Species[d] (range)	19	41 (35,29)
Breeding Species in common with this study[c]	-	12
All species observed[e] (range)	37	55 (51, ?)
Species in common with this study[e]	-	15
Diversity Index[f] (range)	2.34	2.69,3.15

[a]Price and McCallum (1978), McCallum (1979); counts conducted in 1977 and 1978.

[b]Ranges given for multiple estimates (this study) of multiple years of data.

[c]Includes species with partial (< .5) territories on the grid.

[d]Includes only species with $\geq$ .5 territories on the grid.

[e]Includes breeding species, partial breeders, and visitors.

[f]Calculated using breeding species ($\geq$ .5 territories) only.

? - visitors given for only one year.

principally Pinyon/Juniper Woodland and Sagebrush/Grassland stringers. The Agricultural Lands Grid was selected for sampling rather than a tailings site because the Agricultural Lands Habitat Site is assumed to reflect a reclaimed mill tailings site. It was also not physically possible to establish or census a spot-mapping grid on mill tailings due to the extent of open water nor does the spot-mapping method adequately census most waterbirds (IBCC 1970). However, qualitative data were collected on bird use of the Mill Tailings Habitat Site.

Species observed within the islands of Pinyon/Juniper Woodland and Sagebrush/Grassland were typically the same as those seen on the grids in those habitat sites. Waste areas and edges were favored by Mountain Bluebirds and Say's Phoebes. Open water attracted 37 species of ducks, shorebirds, and aerial insect feeders (Table 3-18), some of which were abundant for short periods during spring migration. Large flocks of Cliff Swallows and Violet-green Swallows fed extensively over the water, though these species nested in other habitat sites. White-throated Swifts also fed over tailings ponds, but were much less common than the swallows. Mallards, Killdeer, Spotted Sandpipers, Brewer's Blackbirds, and Red-winged Blackbirds all were breeding species associated with the open water.

Discussion

The Avian Prey Population of the Study Area

There were 85 avian species recorded on spot mapping grids during the spring of 1985. Population estimates were generated for 50 (60%) of these species for the GMSA from the spot mapping data (Table 3-19). Population estimates range from a low of 3 breeding pairs each of Black-capped Chickadees and Warbling Vireos to 1,802 breeding pairs of Black-throated Gray Warblers. Because we had only a single sample for each habitat site, it was not possible to determine confidence limits for these population estimates. However, ranges are provided by the independent estimates made by the two observers. The total estimated breeding population of the 50 species on the GMSA in 1985 is 23,048 pairs (range of estimates: 20,525 (-11%) to 24,731 (+7.3%)) (Table 3-19). This is an average of 1.23 breeding pairs/acre for the entire GMSA.

Table 3-18. Species of birds recorded in association with water areas on the Mill Tailings Habitat Site.

	Abundance[a]	Status[b]
Eared Grebe	U	T
White-faced Ibis	U	T
Green-winged Teal	C	T
Mallard	C	T
Blue-winged Teal	C	T
Cinnamon Teal	U	T
Northern Shoveler	C	T
Gadwall	C	T
American Wigeon	C	T
Redhead	C	T
Ring-necked Duck	C	T
Lesser Scaup	C	T
Hooded Merganser	C	T
Common Merganser	C	T
Ruddy Duck	C	T
American Coot	C	T
Semi-palmated Sandpiper	U	T
Killdeer	C	SR
American Avocet	C	T
Greater Yellowlegs	U	T
Willet	U	T
Spotted Sandpiper	C	SR
Marbled Godwit	U	T
Long-billed Dowitcher	U	T
Common Snipe	U	T
Wilson's Phalarope	C	T
Ring-billed Gull	C	SR
White-throated Swift	A	SR
Tree Swallow	C	T
Violet-green Swallow	A	SR
Northern Rough-winged Swallow	C	T
Cliff Swallow	A	SR
Barn Swallow	C	SR
Mountain Bluebird	C	SR
Water Pipit	A	T
Yellow-rumped Warbler	A	T
Red-winged Blackbird	U	SR
Brewer's Blackbird	C	SR

[a]Abundance Categories
- A - species is almost always seen in large numbers.
- C - species is usually seen in numbers in suitable habitat.
- U - species is not often seen but is not out of range.
- R - species is very infrequently seen in the study area or is out of normal range.

[b]Status Categories
- SR - species occurs principally as a summer resident.
- T - species occurs principally during periods of spring or fall migration; or a wandering species.

Table 3-19. Population estimates for breeding species on the Guadalupe Mountain Study Area, 1985.

	Habitat Sites							
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals (Range)
Canada Goose					V			A[a]
Common Merganser							V	A
Turkey Vulture				V	V		V	A
Osprey							V	A
Cooper's Hawk				V				A
American Kestrel	+					V		A
Rock Dove						V		A
Band-tailed Pigeon						V		A
Mourning Dove	V	277	262		150	V		689 (652-689)
Great Horned Owl					V			A
Northern Saw-whet Owl			V					A
Common Nighthawk	V	V						A
White-throated Swift	V	V		V	V		V	B
Broad-tailed Hummingbird	278	277	112	77	150	11	5	910 (75-1,429)
Hairy Woodpecker		139	75	77				291 (291-291)
Northern Flicker		139	75	77	+			291 (291-291)
Olive-sided Flycatcher			V					A
Western Wood-Pewee					301		15	316 (316-317)
Empidonax spp.							8	8 (7-10)
Gray Flycatcher		139						139 (139-277)
Dusky Flycatcher			112	77	226			415 (415-415)
Say's Phoebe					75			75 (75-75)
Ash-throated Flycatcher		139						139 (139-139)
Horned Lark	V							
Violet-green Swallow	V	277	112	230	V		V	619 (619-619)
Cliff Swallow							66	66 (66-66)
Barn Swallow						11		11 (11-11)
Steller's Jay		V	75	V			2	77 (77-78)

Table 3-19. (Continued).

	Habitat Sites							
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals (Range)
Scrub Jay		+						C
Pinyon Jay	+	+	V		+			C
Clark's Nutcracker		+	+	+	+			C
Black-billed Magpie			V		V	21	V	21 (21-21)
American Crow		V						C
Common Raven	V		V	V	V	V	V	C
Black-capped Chickadee						V	3	3 (3-3)
Mountain Chickadee		832	224	153	V			1209 (1,209-1,209)
Plain Titmouse		1525		153	V			1678 (1,678-1,815)
Common Bushtit		V	V	77				77 (77-77)
Red-breasted Nuthatch		139	75					214 (75-352)
White-breasted Nuthatch		277	37					314 (277-352)
Pygmy Nuthatch		416	224	230				870 (731-870)
Rock Wren				191	188		+	379 (379-455)
Canyon Wren				115				115 (77-154)
House Wren			75	V	226		5	306 (304-308)
American Dipper							13	13 (12-15)
Ruby-crowned Kinglet		V			V		V	
Western Bluebird	V	277	37		V	V		314 (314-314)
Mountain Bluebird	139	V			V			139 (0-139)
Townsend's Solitaire		V	112	77	75		5	269 (267-269)
Veery							V	
American Robin	V	V	+	153	150	V	15	318 (316-321)
Gray Catbird							V	
Sage Thrasher	V							A
Water Pipit						V		M
European Starling						11		11
Solitary Vireo		139	75	77	75			366 (336-366)

Table 3-19. (Continued).

	Habitat Sites							
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals (Range)
Warbling Vireo							3	3 (3-3)
Virginia's Warbler			262	230	150		2	644 (605-680)
Yellow Warbler					188		61	249 (247-249)
Yellow-rumped Warbler			V			V		M
Black-throated Gray Warbler		1802						1802 (1,662-1,802)
Townsend's Warbler		V				V		M
Yellow-breasted Chat					75		7	82 (82-82)
Western Tanager			112	77	+		5	194 (155-196)
Black-headed Grosbeak			37					37 (37-37)
Blue Grosbeak						V	V	A
Lazuli Bunting						V	V	A
Green-tailed Towhee	139			77	150		2	368 (227-368)
Rufous-sided Towhee		139	486	115	338			1078 (966-1,154)
Chipping Sparrow	+	554	V	268		21		843 (805-883)
Brewer's Sparrow	1252							1252 (1,112-1,252)
Vesper Sparrow	1530					21		1551 (1,411-1,829)
Sage Sparrow	1669							1669 (1,669-1,669)
Song Sparrow							21	21 (18-26)
Dark-eyed Junco		693	336		V		5	1034 (857-1,036)
Red-winged Blackbird	V							A
Western Meadowlark	+					42		42 (42-42)
Brewer's Blackbird	V				V	11	20	31 (20-41)
Brown-headed Cowbird		970	224	77	226			1497 (1,358-1,635)
Pine Grosbeak			V					C
Cassin's Finch		V	V	V	V			C
Red Crossbill		+	V	V	V			C
Evening Grosbeak			V					C

Table 3-19. (Concluded).

	Habitat Sites								
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals	(Range)
Pine Siskin		V					C		
American Goldfinch							C		
	5,006	9,149	3,139	2,602	2,745	147	260	23,048	(20,525-24,731)

[a]

A = probable breeding species on study area, but density could not be determined from spot mapping data.

B = colonial nestin species. Populations not accurately measured by spot mapping.

C = flocking, calling, mobile, species; corvids and finches. Difficult to census with spot mapping method.

M = Migrant.

V = Visitor to grid; too few territorial registrations or observations to quantify.

+ = Breeding species with part (but < 0.5) of territory on grid.

Many species of birds were found breeding on more than one grid (Table 3-19). To better understand this phenomonen, the percentage of overlap in breeding species between each pair of grids was calculated using the equation

$$P = \frac{C}{A + B - C}$$

where

P = percent overlap,
C = number of species in common between Habitats A and B,
A = number of species in Habitat A, and
B = number of species in Habitat B.

A total of 21 comparisons were made (Table 3-20). A natural break in the data occurred between 30 and 40 percent. Two thirds (14) of the paired grids had minor ($\leq$ 30.0%) amounts of breeding species overlap. In the remaining seven grids, percent overlap was considered moderate (40.0%$\leq$ P $\leq$ 66.6%)). Six of the seven cases of moderate breeding species overlap were between structurally similar habitats. Five cases were among the four grids (Pinyon/Juniper Woodland, Upland Forest, Wooded Canyon Benches, and Canyon Walls) that were moderately to extensively wooded (Table 3-20). The greatest overlap was between Pinyon/Juniper Woodland and Upland Forest (66.6%), the least was between Pinyon/Juniper Woodland and Wooded Canyon Benches (44.4%). The treeless Sagebrush/Grassland Grid and the nearly treeless Agricultural Lands Grid had 40.0% breeding species overlap. In the last case of moderate breeding species overlap, the Riparian Grid shared 45.8% of its breeding species, largely because of the previously discussed shoreline vegetation present in the latter grid.

Spot mapping does not provide valid estimates of numbers of mobile, flocking, and calling species, such as corvids and late nesting finches. Eleven species of corvids and finches were recorded on grids, sometimes in large flocks, but population estimates could not be made for these species (Table 3-19). White-throated Swifts, obviously abundant over the canyons most of the day, were only visitors on the spot mapping grids. Cliff Swallows, another colonial nester, were probably underestimated. However, density estimates for the Townsend's Solitaire, Yellow Warbler, and Yellow-breasted Chat were probably overstimated (see Canyon Slopes Habitat Site in Results for

Table 3-20. Percent overlap in breeding species composition between the seven habitat sites censused during 1985 on the GMSA.

	Habitat Sites						
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian
Sagebrush/ Grassland	——	08.7	03.8	13.0	15.8	40.0	08.7
Pinyon/Juniper Woodland	——	——	66.6	44.4	29.7	08.0	05.5
Upland Forest	——	——	——	57.7	54.2	03.6	25.0
Wooded Canyon Benches	——	——	——	——	56.5	07.7	21.9
Canyon Slopes	——	——	——	——	——	04.3	45.8
Agricultural Lands	——	——	——	——	——	——	03.8
Riparian	——	——	——	——	——	——	——

detailed discussion). Overall, we believe that the breeding population of the GMSA is larger than the estimate given above, although it is not possible to estimate how much larger it actually is.

Availability of Prey to Peregrine Falcons

Twenty five species of prey known to be utilized by Peregrine Falcons in Colorado and northern New Mexico were encountered on spot mapping grids (Table 3-21. Those species frequently found in eyries are designated in Table 3-21 as Frequent Peregrine Prey, those species sometimes found in eyries or those that, because of their habits and habitats, are probably taken by Peregrine Falcons (Enderson et. al., 1982; Dr. John Hubbard, New Mexico Department of Game and Fish, personal communication 1985) are designated as Available Peregrine Prey in Table 3-21.

There are 13 species of Frequent Prey in Table 3-21. Population estimates have been calculated for nine of these species. Their total estimated breeding population is 2,334 pairs, or approximately 10% of the GMSA's estimated breeding population. The other four Frequent Prey species are White-throated Swifts, Clark's Nutcrackers, Pine Siskins, and Red-winged Blackbirds. The first three species were frequently observed in the GMSA, but we have no estimate of their populations since spot mapping did not adequately sample their numbers.

There are 12 species of Available Prey in Table 3-21. Seven of these species have an estimated total breeding population of 2,651 pairs, or again about 10% of the study area's estimated population. Three of the remaining five species, Red Crossbills, Evening Grosbeaks, and Pinyon Jays were commonly encountered on the GMSA but their numbers could not be estimated by spot mapping. Common Nighthawks occurred on the GMSA, but did not appear to be very numerous. The fifth species, Yellow-rumped Warblers, did not appear to breed on the GMSA, but were abundant migrants on the Mill Tailings Habitat Site in mid-May (Table 3-18).

The Frequent and Available Prey found on the GMSA are not uniformly distributed among the seven sampled habitat types. Sagebrush/Grassland, the

Table 3-21. Population estimates for potential Peregrine Falcon prey breeding species on the Guadalupe Mountain Study Area, 1985.

	Habitat Sites							
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals (Range)
Frequent Peregrine Prey[a]								
Mourning Dove	V	277	262		150	V		689 (652-689)
White-throated Swift	V	V		V	V		V	B
Northern Flicker		139	75	77	+			291 (291-291)
Violet-green Swallow	V	277	112	230	V		V	619 (619-619)
Clark's Nutcracker		+	+	+	+			C
Mountain Bluebird	139	V			V			139 (0-139)
American Robin	V	V	+	153	150	V	15	318 (316-321)
European Starling						11		11
Western Tanager			112	77	+		5	194 (155-196)
Red-winged Blackbird	V							A
Western Meadowlark	+					42		42 (42-42)
Brewer's Blackbird	V				V	11	20	31 (20-41)
Pine Siskin		V						C
Subtotals	139	693	561	537	300	64	40	2,334 (2,095-2,338)

Table 3-21. (Continued).

	Habitat Sites							
	Sage-brush/ Grass-land	Pinyon/ Juniper Wood-land	Upland Forest	Wooded Canyon Benches	Canyon Slopes	Agri-cultural Lands	Ri-parian	Totals (Range)
Available Peregrine Prey[b]								
Common Nighthawk	V	V						
Western Wood-Peewee					301		15	316 (316-317)
Say's Phoebe					75			75 (75-75)
Cliff Swallow							66	66 (66-66)
Steller's Jay		V	75	V			2	77 (77-78)
Pinyon Jay	+	+	V		+			C
Western Bluebird	V	277	37		V	V		314 (314-314)
Townsend's Solitaire		V	112	77	75		5	269 (267-269)
Yellow-rumped Warbler			V			V		M
Black-headed Grosbeak			37					37 (37-37)
Brown-headed Cowbird		970	224	77	226			1497 (1,358-1,635)
Red Crossbill		+	V	V	V			C
Evening Grosbeak			V					C
Subtotals	0	1,247	485	154	677	0	88	2,651 (2,510-2,791)
Totals	139	1,940	1,046	691	977	64	128	4,985 (4,605 5,129)

Table 3-21. (Concluded).

[a]Frequent Peregrine Prey = prey often found in Peregrine Falcon nests (Enderson, et. al. 1982; John Hubbard, New Mexico Department of Game and Fish, personal communication 1985).

[b]Available Peregrine Prey = prey sometimes found in Peregrine Falcon nests and usually available in the vicinity of their nests (Enderson, et. al. 1982; John Hubbard, New Mexico Department of Game and Fish, personal communication 1985)

A = probable breeding species on study area, but density could not be determined from spot mapping data.

B = colonial nesting species. Populations not accurately measured by spot mapping.

C = flocking, calling, mobile, species; corvids and finches. Difficult to census with spot mapping method.

M = Migrant.

V = Visitor to grid; too few territorial registrations or observations to quantify.

+ = Breeding species with part (but < 0.5) of territory on grid.

second largest habitat type on the GMSA, contributed few breeding pairs in either category. The Agricultural and Riparian Habitat Sites, the smallest in size on the GMSA, also contributed few Preferred or Available Peregrine Prey. Thus the wooded and canyon habitat sites provide the majority of the habitat for most of the species that are probably taken as prey by hunting Peregrine Falcons (Table 3-21).

Based on these estimates, there were at least 5,000 breeding pairs of Frequent or Available Peregrine Prey plus their offspring present in the GMSA during the spring of 1985. In addition, there were numerous land and water birds (Table 3-18) passing through or stopping for short periods within the study area. Finally, there are the colonial nesting and flocking species that could not be quantified by spot mapping. This would appear to be a quite adequate prey base to support a local nesting population of Peregrine Falcons. The quality of that prey base is further examined in the following section.

4.0 ORGANOCHLORINE ANALYSIS OF AVIAN PREY

During the last two decades, considerable study has been given to population declines in Peregrine Falcons and other raptors, particularly those feeding on fish or insectivorous birds. Mounting evidence suggests that the primary stress factor is contamination with certain chlorinated hydrocarbons (Wiemeyer and Porter 1970; Cade et al. 1971; Porter and Wiemeyer 1972; Snyder et al. 1973; Peakall 1976; Enderson et al. 1982; Henny et al. 1982; Mendenhall et al. 1983; Springer et al. 1984).

Clark and Krynitsky (1983) recently found large areas of DDT contamination in New Mexico with probable harmful effects to wildlife. Their data indicate a portion of the observed residue levels may be from heavy agricultural use of DDT before it was banned in 1972. However, some of the data indicate there may still be illegal useage of DDT in New Mexico.

Due to the potential threat to Peregrine Falcons from pesticide contamination and the potential impacts the proposed Guadalupe Mountain mill tailings site may have on the prey of local breeding Peregrine Falcons, the BLM funded this study of the organochlorine (OCL) residues in the Peregrine Falcon avian prey species currently nesting on the GMSA. The focus of this portion of the study was to: 1) evaluate the "quality" of local avian prey; 2) evaluate the potential impact the proposed mill tailings site may have on local breeding Peregrine Falcons by creating new habitat for potentially comtaminated prey species, e.g., migratory shorebirds, and reducing the numbers of avian prey with negligible OCL contamination; and 3) provide baseline data for future monitoring programs of environmental pollutant levels in the GMSA.

Methods

Collecting was conducted during the same field visits used to census breeding birds (Section 3.0; Methods). Specimens were collected with 12 and 20 guage shotguns and strategically placed mist nets after completion of early morning censuses. A total of 316 individuals of 35 potential prey species were collected. No specimens were collected within 1/4 mile of any census

grid nor more than one mile outside the study area boundaries. Between two and 20 specimens of each of the 35 species were collected. The species collected were chosen based on the following criteria:

- those species, based on a review of the literature and Eagle Environmental's experience with avian communities in northern New Mexico, that are abundant in the different habitat types on the study area and are considered preferred prey of local Peregrine Falcons;
- those species known to be common prey of local Peregrine Falcons based on prey remains data and observations of hunting behavior collected in other investigations (John Hubbard, New Mexico Department of Game and Fish, personal communication 1985); and
- those species found to be abundant during initial spot mapping censuses, assuming the abundant species incur a higher rate of predation.

Freshly collected specimens were prepared for analysis (skinned with bills, wings, GI tract, and legs removed), labeled, wrapped in foil, and frozen for shipment to Hazleton Raltech, Inc., Madison, Wisconsin. A specimen collection log was maintained and each bird collected was individually recorded. Information recorded included species, date, habitat site, and legal description (to 1/4 section) of the collection site. The completed log was submitted to the Taos Area Office, BLM, with this report.

The individuals of each species were homogenized as a pool, resulting in one pooled sample per species. The number of individuals within each pool are presented in Table 4-1. Each sample was analyzed for percent lipid composition and concentrations of the following OCL compounds: p,p'DDE (DDE), p,p'DDD (DDD), p,p'DDT (DDT), polychlorinated biphenyls (PCBs), dieldrin, alpha-benzene hexachloride, hexachloro benzene, endrin, heptachlor epoxide, mirex, toxaphene, and oxychlordane. The analysis methods are described in detail in Heath and Hill (1974) and are summarized below.

A 40-g aliquot of each pool was allowed to dry, mixed with anhydrous sodium sulfate, and subjected to Soxhlet extraction with 300 ml of a 70:170 mixture of ethyl ether:petroleum ether for 8 hrs. The extract was eluted

Table 4-1. Organochlorine residue levels in pools of prey species available to Peregrine Falcons on the GMSA.

Category and Species	N[a]	Residues (ppm. wet weight) % Lipid	DDE	PCB[b]	Dieldrin	Other OCL[c]
Resident[e] Herbivore[f]						
Pinyon Jay	15	3.9	0.03	ND[d]	ND	0.03
Clark's Nutcracker	10	3.4	0.09	ND	ND	ND
Red Crossbill	10	7.2	0.02	ND	ND	ND
Pine Siskin	10	6.0	0.18	ND	0.01	ND
Weakly Migratory[g] Herbivore						
Mallard	5	6.5	0.10	ND	ND	ND
Mourning Dove	10	5.7	0.02	ND	ND	ND
Evening Grosbeak	10	4.7	<0.01	ND	0.01	ND
Strongly Migratory[h] Herbivore						
Vesper Sparrow	10	4.1	2.38	ND	ND	ND
Resident Omnivore						
Northern Flicker	10	4.5	0.06	ND	ND	<0.01
Steller's Jay	10	8.9	0.04	ND	ND	0.03
Black-billed Magpie	10	4.1	0.20	0.20	ND	0.03
European Starling	10	3.1	1.96	0.13	<0.01	0.02
Rufous-sided Towhee	10	3.6	0.07	ND	ND	ND
Weakly Migratory Omnivore[i]						
Horned Lark	10	3.8	0.17	ND	0.02	0.03
Townsend's Solitaire	3	5.5	0.06	ND	ND	ND
American Robin	10	5.9	1.56	ND	ND	0.14
Red-winged Blackbird	10	3.0	0.13	ND	ND	ND
Western Meadowlark	10	4.6	6.25	ND	ND	ND
Strongly Migratory Omnivore						
Blue-winged Teal	5	20.5	0.62	ND	0.02	0.09
Marbled Godwit	2	19.6	0.23	ND	0.01	0.02
Brewer's Blackbird	10	5.1	5.28	ND	<0.01	0.10
Brown-headed Cowbird	10	3.7	0.31	ND	<0.01	0.04
Resident Insectivore/Carnivore						
Hairy Woodpecker	4	3.5	0.01	ND	ND	ND

Table 4-1. (Concluded).

Category and Species	N[a]	% Lipid	Residues (ppm. wet weight) DDE	PCB[b]	Dieldrin	Other OCL[c]
Weakly Migratory Insectivore/Carnivore						
Killdeer	10	6.8	13.49	ND[d]	0.15	0.31
Belted Kingfisher	5	6.2	4.59	1.42	0.02	0.51
Mountain Bluebird	20	6.1	0.76	ND	ND	0.02
Sage Thrasher	10	5.9	0.14	ND	ND	ND
Strongly Migratory Insectivore/Carnivore						
Willet	2	20.8	4.74	ND	0.04	0.37
Spotted Sandpiper	10	9.4	1.04	ND	0.04	0.06
White-throated Swift	10	9.4	0.78	ND	ND	0.07
Say's Phoebe	5	6.0	22.01	ND	0.02	0.03
Violet-green Swallow	10	10.4	2.21	0.26	0.02	0.35
Cliff Swallow	10	13.2	1.31	ND	ND	0.07
Water Pipit	10	7.0	11.63	ND	0.01	0.24
Yellow-rumped Warbler	10	6.6	0.37	ND	ND	ND

[a]N = the number of individuals in each pooled sample; one pooled sample per species.

[b]The only PCB compound identified in the samples was Aroclor 1260.

[c]The other OCL compunds include: DDD, DDT, alpha-benzene hexachloride, beta-benzene hexachloride, lindane, delta-benzene hexachloride, hexachloro benzene, endrin, heptachlor epoxide, mirex, toxaphene, and oxychlordane.

[d]ND = not detected.

[e]Food habits based on Martin et al. (1961).

[f]Status based on Hubbard (1978) and arrival dates observed in this study.

[g]Weakly migratory = a species in which some individuals do an altitudinal migration or move short distances (up to several hundred miles) latitudinally for the winter. Other individuals of this species remain resident throughout the year. Most individuals remain within the United States throughout the winter.

[h]Strongly migratory = a species in which almost all individuals winter outside of the United States.

[i]Omnivore = animal prey comprises 75+% of diet, by dry weight.

through a standardized Florisil column with 250 ml of a mixture (3:1) of hexane:benzene, partitioned into acetonitrile, and passed a second time through a Florisil column. The eluate was concentrated and made to volume. Half the Florisil eluate was used to measure OCL pesticides and the second half was reserved for PCB analysis. Percent lipids were measured by drying a 25-ml aliquot of the Soxhlet extract.

Pesticides were separated from PCBs using thin-layer chromatography. Residues of OCL's and PCB's were quantified on a 3% OV-17 with confirmation on a 5% DC-200 and a 3% XE-60 G.C.O. gas chromatograph column. PCB determinations were derived using semiquantitative thin-layer methods. All PCB samples were read by comparison of total area with an Aroclor 1254 standard. The lower limit of detection was 0.005 ppm for all compounds except PCBs (0.01 ppm), mirex (0.01 ppm), and toxaphene (0.10 ppm). Residues were not analyzed for percent recovery. Residues are reported as ppm wet weight. They may be converted to lipid weight residues by dividing the wet weight values by the percent lipid of the samples (Table 4-1).

Results

There was wide variation in OCL levels among the 35 potential prey species (Table 4-1). Residues of DDE were found in all species, ranging from 0.008 ppm in Evening Grosbeaks to 22.01 ppm in Say's Phoebes. Thirteen (37%) of the species pools contained residues >1.0 ppm. The Say's Phoebe (22.01), Killdeer (13.49), Water Pipit (11.63), Western Meadowlark (6.25), and Brewer's Blackbird (5.28) pools had residue levels >5.0 ppm. The lowest DDE residues were found in Mourning Dove (0.02 ppm), Hairy Woodpecker (0.01 ppm), Pinyon Jay (0.03 ppm), Red Crossbill (0.02 ppm), and Evening Grosbeak (0.008 ppm) pools.

Residues of PCBs were detected in the Belted Kingfisher (1.42 ppm), Violet-green Swallow (0.26 ppm), Black-billed Magpie (0.20 ppm), and European Starling (0.13 ppm). Small amounts of residues of dieldrin and other OCL compounds were found in 15 (43%) and 21 (60%) species pools, respectively.

We grouped the 35 species by their predominant food habits and migratory status to characterize the potential sources of DDE to Peregrine Falcons (Table 4-2). Migratory and non-migratory insectivores and carnivores had average DDE residues >4.0 ppm. Resident omnivore residue levels averaged 0.5 ppm while migratory omnivores had residue levels >1.6 ppm. Residue levels were low in weakly-migratory and resident herbivore species, but the Vesper Sparrow (the only strongly-migratory herbivore) had a pool residue level of 2.38 ppm. Despite great variation, DDE levels among migratory insectivorous and carnivorous prey were clearly higher than among non-migratory insectivores, omnivores, and herbivores. With the exception of weakly-migratory herbivores, DDE residues in migratory species were always higher than non-migratory species of equivalent food habits. These results are similar to the findings of Enderson et al. (1982) and DeWeese et al.(in press).

Discussion

It is difficult to correlate the residues we found in prey in the GMSA with the OCL-related reproductive effects reported by other investigators because 1) prey selection by Peregrine Falcons in and adjacent to the study area is difficult to predict, 2) the amount of foraging time spent in the GMSA by local Peregrine Falcons is unknown, and 3) there is great variation of OCL contamination in potential prey (Table 4-1). However, based on a review of the literature, qualitative inferences can be made about the extent to which local Peregrine Falcons are threatened by OCL compounds.

Newton and Bogan (1978) concluded that PCBs have not been linked to eggshell thinning in field or controlled laboratory studies of Sparrowhawks (Accipiter nisus). DDE and PCBs appeared to interact in reducing breeding success of American Kestrels (Lincer 1972) and Mallards (Risebrough and Anderson 1975). McLane and Hughes (1980) found no effect on eggshell thickness, young hatched, and young fledged in captive Eastern Screech Owls (Otus asio) fed PCBs where levels ranged from 3.9-17.8 ppm in egg contents. Enderson et al. (1982) found PCBs averaged about 2 ppm in egg contents of Peregrine Falcons in Colorado and northern New Mexico. They concluded that there is no evidence PCBs have impaired falcon reproduction. In this study, PCBs were

Table 4-2. Average DDE levels in Peregrine Falcon prey grouped by food habits and migration status.[a]

Status	DDE (ppm, wet weight) Herbivore	Omnivore	Insectivore/ Carnivore
Resident	0.08 (0.07)[b]	0.47 (0.84)	0.01
Weakly Migratory	0.04 (0.05)	1.63 (2.65)	4.75 (6.15)
Strongly Migratory	2.38	1.61 (2.45)	5.51 (7.63)

[a]Status and food habits of each species collected are identified in Table 4-1.

[b]Arithmetic mean (standard deviation).

detected in only four species, and the Belted Kingfisher was the only species with PCB residues >1.0 ppm (1.42 ppm).

Mendenhall et al. (1983) fed captive Barn Owls (Tyto alba) diets containing 3.0 ppm DDE and 0.5 ppm dieldrin; doses were given separately and in combination for two years. DDE was associated with significant eggshell thinning, egg breakage, embryo mortality, and reduced production per pair. Dieldrin alone was associated with slight eggshell thinning, but not with reduction of breeding success. Dieldrin was also associated with adult mortality. The dieldrin results of this study are consistent with other studies conducted on Galliformes (DeWitt 1956; Graves et al. 1969; Wiese et al. 1969; Dahlgren and Linder 1974). Mendenhall et al. (1983) suggest that DDE has a much more severe effect on reproduction in wild raptors than dieldrin, which contributes to their decline primarily through adult mortality.

All prey species in this study had dieldrin residues of 0.15 ppm or less. This is less than the 0.5 ppm fed the Barn Owls by Mendenhall et al. (1983). Based on the residue levels reported in this study and the published information, we conclude that in isolation PCBs, dieldrin, and the other OCL compounds examined in this study are currently not a threat to the reproduction or survivability of Peregrine Falcons using the area. However, this does not take into account possible effects of these contaminants occurring in combination.

Several laboratory and field studies have found eggshell thinning, egg breakage, embryo mortality, and overall reduced production in birds fed DDE. Captive Black Ducks (Anas rubripes) and Mallards produced eggshells 8 to 22% thinner than controls when fed about 3 ppm DDE (wet weight) for periods up to a year (Heath et al. 1969; Longcore and Samson 1973). Ringed Turtle-Doves (Streptopelia risoria) fed about 3 ppm DDE (wet weight) produced eggshells 9.2% thinner than controls (Peakall et al. 1973).

Among raptors, Eastern Screech Owl eggshells were found to be 13.3% thinner than controls when fed a diet containing 2.8 ppm DDE (McLane and Hall 1972). American Kestrels fed a diet containing 3 ppm DDE 2-3 months prior to egg-laying produced eggshells 14% thinner than controls (Lincer 1975). Dose-

response curves calculated in that study predicted that 1 ppm of DDE would produce about 7% thinning, and 2 ppm DDE about 11% thinning. Wild kestrels showed a similar shell thinning response to DDE.

Based on the results of their study and review of the literature, Enderson et al. (1982) concluded that a diet containing 1.0 ppm DDE or more could be expected to produce the 13% eggshell thinning observed in eggs from Colorado and New Mexico Peregrine Falcons. DDE residues averaged 20 ppm in egg contents analyzed in their study. Peakall (1976) predicted 15–20 ppm DDE is the level at which hatching failure occurs.

We also used a 1.0 ppm residue level (Enderson et al. 1982) as a criterion for categorizing prey species on the GMSA as to their potential risk to Peregrine Falcons hunting in the area. Prey available to Peregrine Falcons in the GMSA showed extreme variation in DDE contamination (Table 4-1). However, since only a single pool was analyzed for all species, care must be taken in interpreting the reported residue values because of occasional wide variation between pools for the same species. To insure careful interpretation, the results of this study were compared with results from similar studies (Enderson et al. 1982; Clark and Krynitsky 1983; DeWeese et al., in press) (Table 4-3). These studies were used for the comparison because their data sets included substantial numbers of specimens from New Mexico and southern Colorado. Enderson et al. (1982) focused on residues in known or potential peregrine prey collected in northern New Mexico and Colorado. Clark and Krynitsky (1983) present residue levels for a wide spectrum of wildlife species in New Mexico and Arizona. The residue data in Table 4-3 from Clark and Krynitsky are for species pools collected in northern New Mexico. DeWeese et al. (in press) present OCL residue levels for a large spectrum of Peregrine Falcon prey collected near eyrie sites in eight western states. The data in Table 4-3 from DeWeese et al. (in press) represent average residue levels for this range. However, only those species with composite pools of specimens collected in New Mexico or southern Colorado were used in this comparison. Table 4-3 contains data only for species analyzed in this study and in at least one of the other studies.

Table 4-3. Average DDE residues in avian species collected in New Mexico.[a]

Species	This Study	Enderson et. al. (1982)	Clark and Krynitsky (1983)	DeWeese et al. (in press)
Mallard	0.10	NA[b]	< 0.10	NA
Killdeer	13.49	19.50	NA	NA
Mourning Dove	0.02	0.21	5.38	0.05
White-throated Swift	0.78	1.50	NA	1.88
Northern Flicker	0.06	0.06	NA	0.07
Say's Phoebe	22.01	2.00	7.10	NA
Violet-green Swallow	2.21	5.90	3.87	4.13
Cliff Swallow	1.31	2.00	3.68	3.18
Steller's Jay	0.04	0.51	NA	0.07
Pinyon Jay	0.03	0.12	NA	NA
Clark's Nutcracker	0.09	0.04	NA	NA
American Robin	1.56	0.52	NA	0.67
Mountain Bluebird	0.76	0.10	NA	NA
Townsend's Solitaire	0.06	0.28	NA	NA
European Starling	1.96	0.45	15.80	< 0.70
Yellow-rumped Warbler	0.37	0.97	NA	< 0.70
Western Meadowlark	6.25	0.86	6.11	0.61
Red-winged Blackbird	0.13	0.49	NA	0.20
Brewer's Blackbird	5.28	6.00	NA	5.32
Brown-headed Cowbird	0.31	1.20	NA	< 0.70
Red Crossbill	0.02	0.02	NA	NA
Pine Siskin	0.18	0.08	NA	NA

[a] Only those species represented by pools of specimens collected in New Mexico and southern Colorado were used in this comparison. Composite arithmetic means from Table 4 are reported.

[b] NA = not available.

Considerable variation exists between the results of the four studies, emphasizing the variability that can occur between pools within a species. Despite this variability, the prey species that clearly represent major sources of DDE to Peregrine Falcons in the study area and throughout northern New Mexico can be identified.

Of the 22 species in Table 4-3, 11 (50%) consistently had residues <1.0 ppm. These species and the additional eight species collected in this study (but not documented in the other two studies) with DDE residues <1.0 ppm (Blue-winged Teal, Marbled Godwit, Hairy Woodpecker, Horned Lark, Black-billed Magpie, Sage Thrasher, Rufous-sided Towhee, and Evening Grosbeak) are currently not a major source of DDE contamination for local breeding Peregrine Falcons. This group of 19 species includes four resident herbivores, two weakly-migratory herbivores, four resident omnivores, five migratory omnivores, one resident insectivore, and three migratory insectivores (Table 4-2).

Those prey species with DDE levels between 1-2 ppm in any one of the four studies are considered moderate-risk prey species. In general, these are species with residue levels that are inconsistent between studies (vary between very low ppm to 1.5-2.0 ppm) or are between 1-2 ppm in one pool from this study and require further investigation. These moderate-risk species include: White-throated Swifts, American Robins, Brown-headed Cowbirds, and Spotted Sandpipers. This group includes two migratory omnivores and two migratory insectivores.

Twelve of the 35 prey species (29%) considered in this study had DDE residues >2.0 ppm in at least one study. These species are considered to be a major potential source of DDE contamination for local Peregrine Falcons. These species are: Killdeer, Willets, Mourning Doves, Say's Phoebe, Violet-green Swallows, Cliff Swallows, European Starlings, Western Meadowlarks, Brewer's Blackbirds, Belted Kingfishers, Water Pipits, and Vesper Sparrows. Of the 12 species, 58% (7) are strongly-migratory (Table 4-2) and could be accumulating DDE residues on their wintering grounds. The remaining five species (Killdeer, Mourning Doves, European Starlings, Western Meadowlarks, Belted Kingfishers) are weakly-migratory or residents known to winter in this area (Hubbard 1978). Clark and Krynitsky (1983) summarized a large data base

on pesticide levels of various wildlife species in the southwest and concluded that wildlife species have been exposed to DDT in New Mexico, Arizona, and southern Texas since the 1972 ban. The southern Rio Grande river valley was suggested by Clark and Krynitsky to be a heavily contaminated area in New Mexico. The source of this DDT is unknown. In addition, White et al. (1983) found that DDE residues increased significantly in shorebirds after they arrived on the south Texas coast from their breeding grounds. This study demonstrates that aquatic areas near agricultural lands on the south Texas coast may still be a potential threat to waterbirds eight years after the DDT ban (data were collected in 1980). Aquatic areas near agricultural lands in southern New Mexico may also be a source of DDT contamination for the species using agricultural habitat sites, e.g., European Starling, Mourning Dove, and Western Meadowlark, and aquatic habitat sites, e.g., Killdeer and Belted Kingfisher.

Local illegal useage of DDT is probably not the source of the DDE residues in the resident and weakly-migratory species on the GMSA. DDT and DDD were rarely detected in our samples which suggests little recent input of DDT into the local environment. These species may be wintering in DDT contaminated areas in southern New Mexico. More information is needed on the wintering areas of these species before the source of this contamination can be identified.

The creation of new aquatic areas (mill tailings ponds) on the GMSA could potentially increase the availability of prey species heavily contaminated with DDE and decrease the availability of low-risk prey species through removal of the Upland Forest and Pinyon-Juniper Woodland Habitat Sites (77% of the acreage at the proposed mill tailings site). The dominant prey species in these two sites are predominantly low and moderate-risk prey (Table 4-1 and Section 3.0). However, of the 12 high-risk species in this study, three species (Killdeer, Willet, and Water Pipit) were only encountered near Molycorp's existing mill tailings ponds, and two species (Violet-green Swallow and Cliff Swallow) were encountered in large flocks foraging over or near the ponds (Section 3.0). Large flocks of Cliff Swallows were also encountered in the Riparian Habitat along with the Belted Kingfisher and Brewer's Blackbird (Section 3.0). Belted Kingfishers could potentially occur near any aquatic

habitat although none were observed near the existing mill tailings ponds. Sizable populations of Brewer's Blackbirds were observed in the disturbed habitats adjacent to the ponds. The European Starling was encountered in small numbers in disturbed habitats throughout the GMSA. The Say's Phoebe, Western Meadowlark, and Vesper Sparrow were common in the lower elevation habitat types throughout the study area (including the tailings ponds), but were uncommon or absent in the Upland Forest and Pinyon-Juniper Woodland Habitat Sites (Section 3.0).

Based on the results of this study, we conclude that the Peregrine Falcons utilizing the GMSA and similar sites in northern New Mexico are faced with a potential source of DDE contamination that could affect their reproductive success. The source of the DDE contamination is unknown but it may be from wintering areas in agricultural and aquatic habitats in southern New Mexico as well as from wintering areas in Latin America. The development of new mill tailings ponds on the GMSA could potentially increase this threat to their reproductive success by providing additional acres of habitat that attracts concentrations of highly contaminated prey such as migrant shorebirds and swallows.

5.0 MANAGEMENT RECOMMENDATIONS

The GMSA, because of the variety of habitat sites it contains, supports an abundant and diverse breeding and transient avifauna. During the fall of 1984 and the spring of 1985, 133 species were recorded on the GMSA (Table 3-1). Of these 133 species, 55 (42%) were documented as breeding species. GMSA habitat sites appear to support substantial and diverse breeding populations of birds (Table 3-19). The estimated breeding bird density for the GMSA during 1985 is 23,048 pairs. The estimated populaton densities for each habitat site within the GMSA are:

- Pinyon-Juniper Woodland - 9,149 pairs,
- Sagebrush/Grassland - 5,006 pairs,
- Upland Forest - 3,139 pairs,
- Canyon Slopes,- 2,745 pairs,
- Wooded Canyon Benches - 2,602 pairs,
- Riparian - 260 pairs, and
- Agricultural Land - 147 pairs.

Of these 23,000 pairs, approximately 20% (5,000) (Table 3-21) are species that are known to be utilized by Peregrine Falcons (Enderson et al. 1982). These 10,000 birds plus those species whose populations could not be estimated by spot-mapping techniques, e.g., jays, swallows, swifts, and the offspring of all these birds, provide a substantial prey base for local Peregrine Falcons. Although the actual availability of the individual prey species is unknown and probably highly variable, and the amount of foraging time spent by local Peregrine Falcons on the GMSA is unknown, the GMSA appears to support a prey population that is more than adequate in size to support the local breeding Peregrine Falcons.

However, there are three land management practices that could potentially occur in the GMSA that would reduce the local avian breeding population and consequently lower prey availability for local breeding Peregrine Falcons. The first practice is intensive fuelwood removal from the Pinyon-Juniper Woodland Habitat Site. Although avian density data were not collected in woodlands subjected to intensive timber management practices, the effect of canopy removal in the GMSA on avian nesting populations can be predicted based

on the results of a study by O'Meara et al. (1981). They compared avian breeding populations in 8- and 15-year old chained areas with unchained woodlands in northwestern Colorado. Their data indicate complete canopy removal of woodland habitat via chaining results in an avian community with 60-70% fewer species, and 60% fewer individuals. Although canopy removal through intensive fuelwood sales in woodland habitat does not remove as much vegetation as chaining, both techniques remove the overstory. Overstory removal changes the structural diversity and microclimate of a site which will effect avian diversity and density. We predict that canopy removal on the GMSA will reduce avian breeding densities by 50-60% within the treatment areas. Based on the 1985 density estimate for the Pinyon-Juniper Woodland Habitat on the GMSA, this will reduce the woodland breeding population by 180-200 pairs/km^2 of treated woodland.

The second potential forest management practice of concern is logging of commercial trees, Ponderosa Pine and Douglas Fir, from the Upland Forest Habitat Site. As discussed in Section 2.0, Guadalupe Mountain apparently does not attain climatic and edaphic conditions necessary for a true mixed conifer forest. Yet the large pines and firs that do occur in this site are a very important structural component in the nesting habitat of breeding birds. They provide an additional feeding and nesting stratum to the avian community. This habitat site supported the second highest population density (500 pairs/km^2) and also ranked second in species diversity (H = 2.79) of the seven study area habitat sites. Commercial size trees are at low density in the Upland Forest, yet their removal could noticeably decrease the numbers and diversity of the breeding bird populations. Further, birds breeding in this site are generally among the least contaminated by pesticides (Section 4.0). Therefore, removal of commercial trees could, by decreasing upland forest birds, make local Peregrine Falcons more dependent upon more contaminated prey species from other habitat sites (see below).

The third land management practice of concern is the proposed mill tailings site which is predicted to remove 1,320 acres of existing vegetaton (USDI-BLM 1983). The affected habitat sites are approximately 895 acres of Pinyon-Juniper Woodland, 300 acres of Sagebrush/Grassland, and 125 acres of Upland Forest. Based on the density estimates for these habitat sites in the

GMSA, the development of the proposed mill tailings site will remove nesting habitat for 1,820 breeding pairs (8% of the total nesting population on the GMSA). If this is done in conjunction with Pinyon-Juniper Woodland fuelwood removal and commercial logging of the Upland Forest Habitat Site, avian breeding densities in the forested habitats could be reduced significantly.

Reclamation of the mill tailings sites will provide avian nesting habitat and mitigate some of the impact of habitat removal on avian populations. However, the reclaimed sites (as represented by the Agricultural Land Grid) support fewer species and lower densities than the native communities (Table 3-19).

In addition to reducing the quantity of prey available to local Peregrine Falcons, the addition of new mill tailings ponds could have a significant effect on their reproductive success by creating habitats that attract "poor quality" prey. A total of 36 species were associated with the existing mill tailings ponds and adjacent disturbed habitats on Molycorp's property (Table 3-18). These species were predominantly waterfowl (15 species), shorebirds (11 species), swallows (5 species), and blackbirds (2 species); many of these species have moderate to high levels of DDE contamination.

Of the 35 potential prey species analyzed for DDE levels in this study, 16 species had residue levels >1.0 ppm. These species are potential sources of DDE contamination for local breeding Peregrine Falcons. Of these 16 species, four species were only associated with the mill tailings ponds and adjacent disturbed habitats (Spotted Sandpiper (1.04 ppm), Killdeer (13.49 ppm), Willet (4.74 ppm), and Water Pipit (11.63 ppm). The Violet-green Swallow (2.21 ppm) and Cliff Swallow (1.31 ppm) foraged in large flocks over the mill tailings ponds. Say's Phoebes (22.01 ppm), Brewer's Blackbirds (%.28 ppm), Western Meadowlarks (6.25 ppm), and Vesper Sparrows (2.38 ppm) were common in the disturbed areas adjacent to the ponds. Although these four species were uncommon to common in the lower elevation habitat types throughout the GMSA, they were rare to absent in the Upland Forest and Pinyon-Juniper Woodland Habitat Sites, which comprise 77% of the acreage of the proposed mill tailings site.

Additional shorebird species were recorded using the mill tailings ponds during the study. Migrant shorebirds are common prey for Peregrines during migration, courtship, egg laying, and incubation. As indicated by the Killdeer, Willets, and Spotted Sandpipers sampled in this study, and the results of other studies on OCL residue levels in migrant shorebirds (Section 4.0), all of the shorebirds utilizing the mill tailings ponds also represent a potential source of DDE contamination for the local Peregrine Falcons. The development of new mill tailings ponds on the GMSA is a potential negative impact to the reproductive success of the local Peregrine Falcons because it creates additional acreage of habitat sites that attract concentrations of prey highly contaminated with DDE such as migrant shorebirds, swallows, and blackbirds.

Based on the results of this study, we recommend:

- minimal canopy removal of the Pinyon-Juniper Woodland Habitat. We recommend thinning practices if fuelwood harvest is deemed necessary on the GMSA and if thinning practices maintain vegetative age class diversity;
- no commercial logging should be planned for the GMSA. The Ponderosa Pine and Douglas Fir densities are low on the GMSA, but those that are present are important nesting, foraging, and roosting sites for the local avian breeding population; and
- selecting an alternative site for the proposed mill tailings site that is not located within potential hunting territories of nesting Peregrine Falcons. If the GMSA is chosen for the mill tailings site, reclamation of tailing ponds should proceed as quickly as possible to minimize the availability of aquatic and disturbed habitats with contaminated prey.

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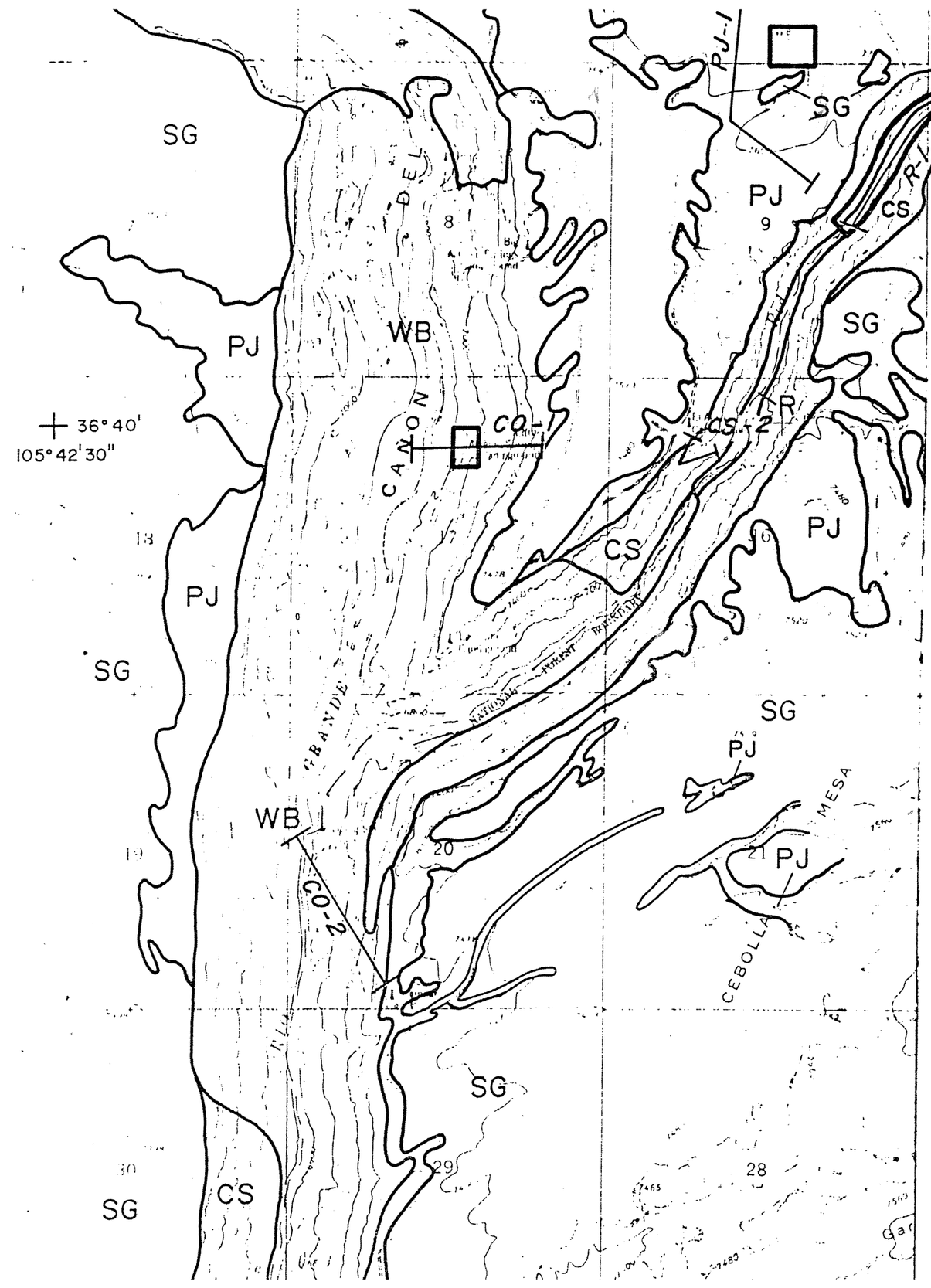
A.0 APPENDIX A - GUADALUPE MOUNTAIN STUDY AREA MAP



AVIAN HABITATS
GUADALUPE MOUNTAIN STUDY AREA
TAOS COUNTY, NEW MEXICO

Prepared by

EAGLE ENVIRONMENTAL, INC.

for

THE BUREAU OF LAND MANAGEMENT
TAOS RESOURCE DISTRICT, N.M.

December, 1985

SG	SAGEBRUSH/GRASSLAND
PJ	PINYON-JUNIPER WOODLAND
UF	UPLAND FOREST
WB	WOODED CANYON BENCHES
CS	CANYON SLOPES
R	RIPARIAN
	DISTURBED HABITAT
	SPOT-MAPPING GRID
T-1	VEGETATION TRANSECT
	MOLYCORP PROPERTY BOUNDARY

STUDY AREA

BASE MAP FROM U.S.G.S. 7.5 MIN. TOPO. QUADS.: GUADALUPE MOUNTAIN, CERRO, SUNSHINE, AND QUESTA, NEW MEXICO

SCALE 1:24,000

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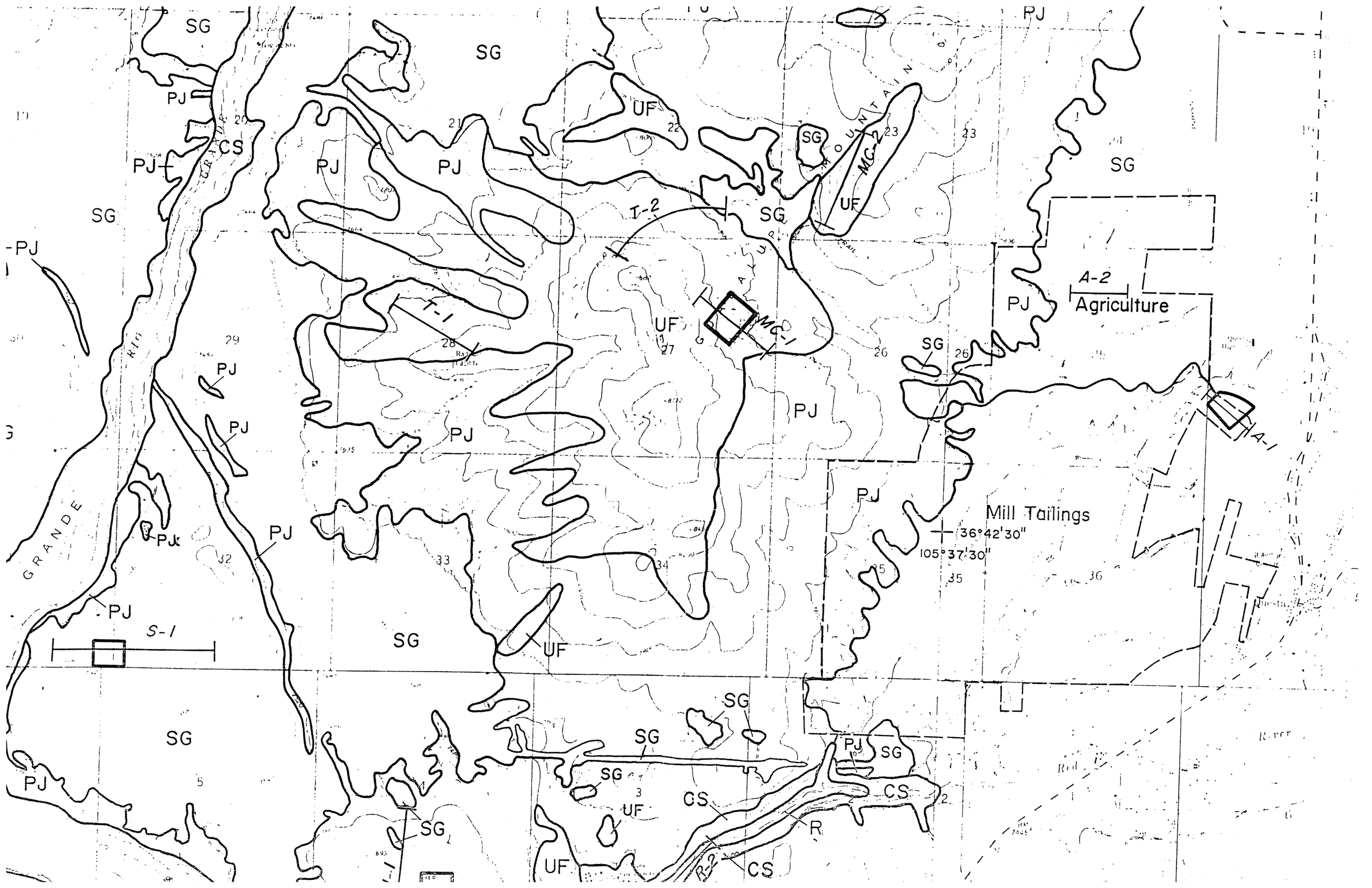
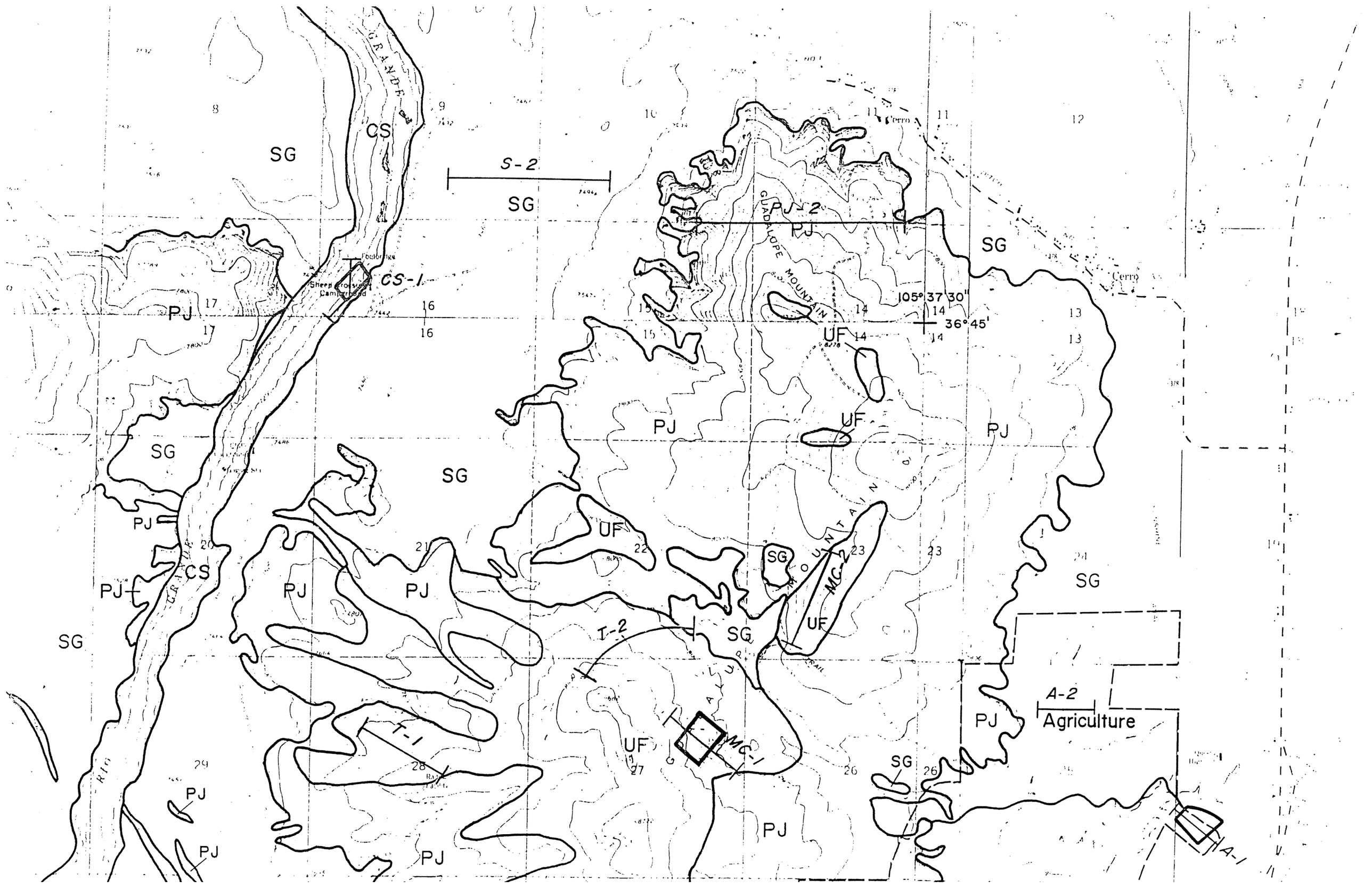
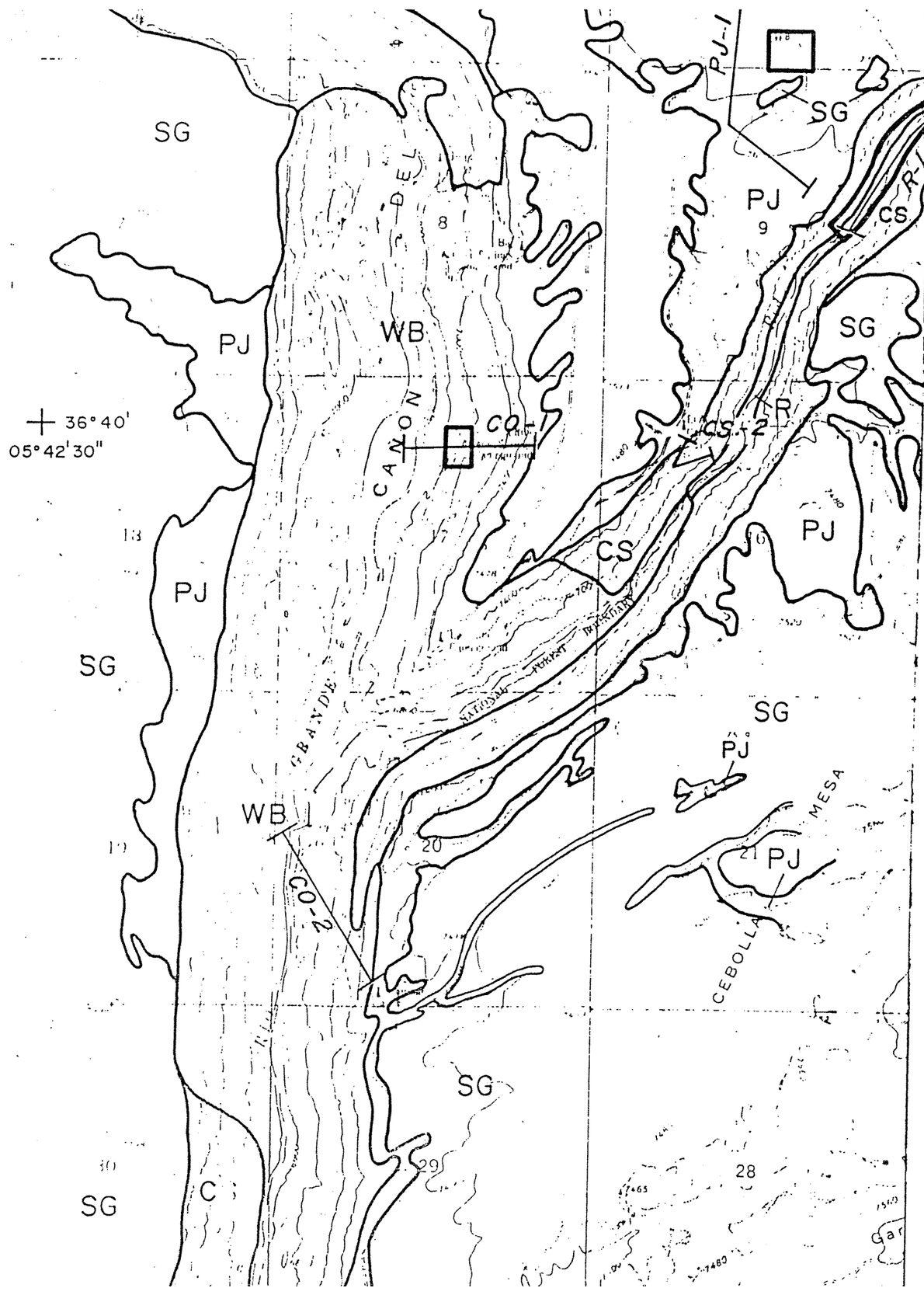

SG
PJ
UF
CS
T-1
T-2
MG-1
MG-2
A-1
A-2
Agriculture
Mill Tailings
36°42'30"
105°37'30"
S-1
R-2
R
RIO GRANDE


RIO GRANDE
CS
SG
S-2
SG
PJ-2
PJ
GUADALOPE MOUNTAIN
Cerro
105°37'30"
36°45'
PJ
17
16
Sheep crossing
Campground
CS-1
SG
UF
PJ
UF
PJ
SG
PJ
PJ
PJ
UF
SG
MG-2
UF
SG
I-2
SG
A-2
Agriculture
PJ
T-1
UF
MG-1
SG
PJ
PJ
PJ
A-1



AVIAN HABITATS
GUADALUPE MOUNTAIN STUDY AREA
TAOS COUNTY, NEW MEXICO

Prepared by

EAGLE ENVIRONMENTAL, INC.

for

THE BUREAU OF LAND MANAGEMENT
TAOS RESOURCE DISTRICT, N.M.

December, 1985

SG	SAGEBRUSH/GRASSLAND
PJ	PINYON-JUNIPER WOODLAND
UF	UPLAND FOREST
WB	WOODED CANYON BENCHES
CS	CANYON SLOPES
STUDY AREA	BASE MAP FROM U.S.G.S. 7.5 MIN. TOPO. QUADS.: GUADALUPE MOUNTAIN, CERRO, SUNSHINE, AND QUESTA, NEW MEXICO

R	RIPARIAN
	DISTURBED HABITA
	SPOT-MAPPING GR
T-1	VEGETATION TRAN
	MOLYCORP PROPER BOUNDARY

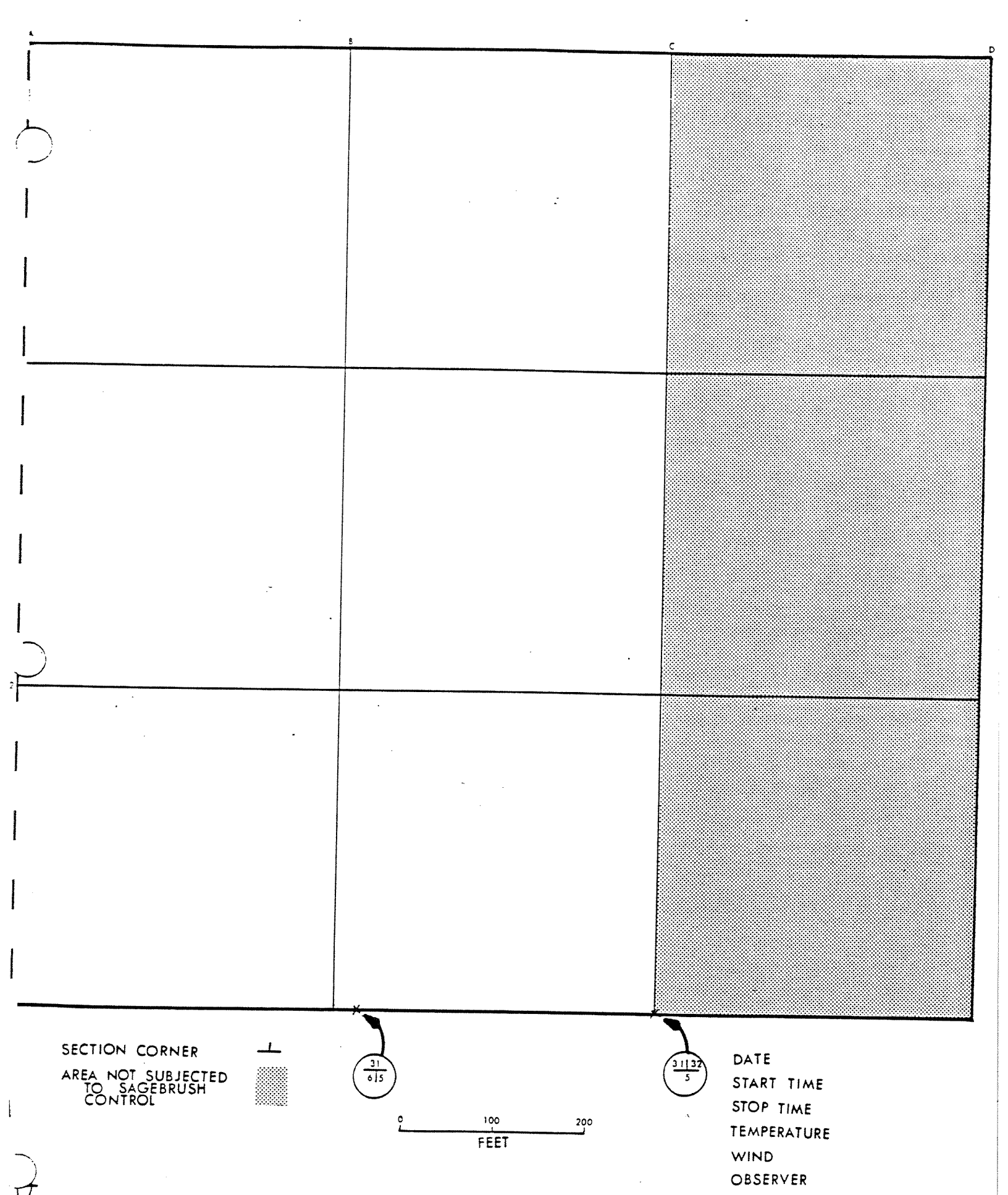
SCALE 1:24,000

0 1/2 1 MI

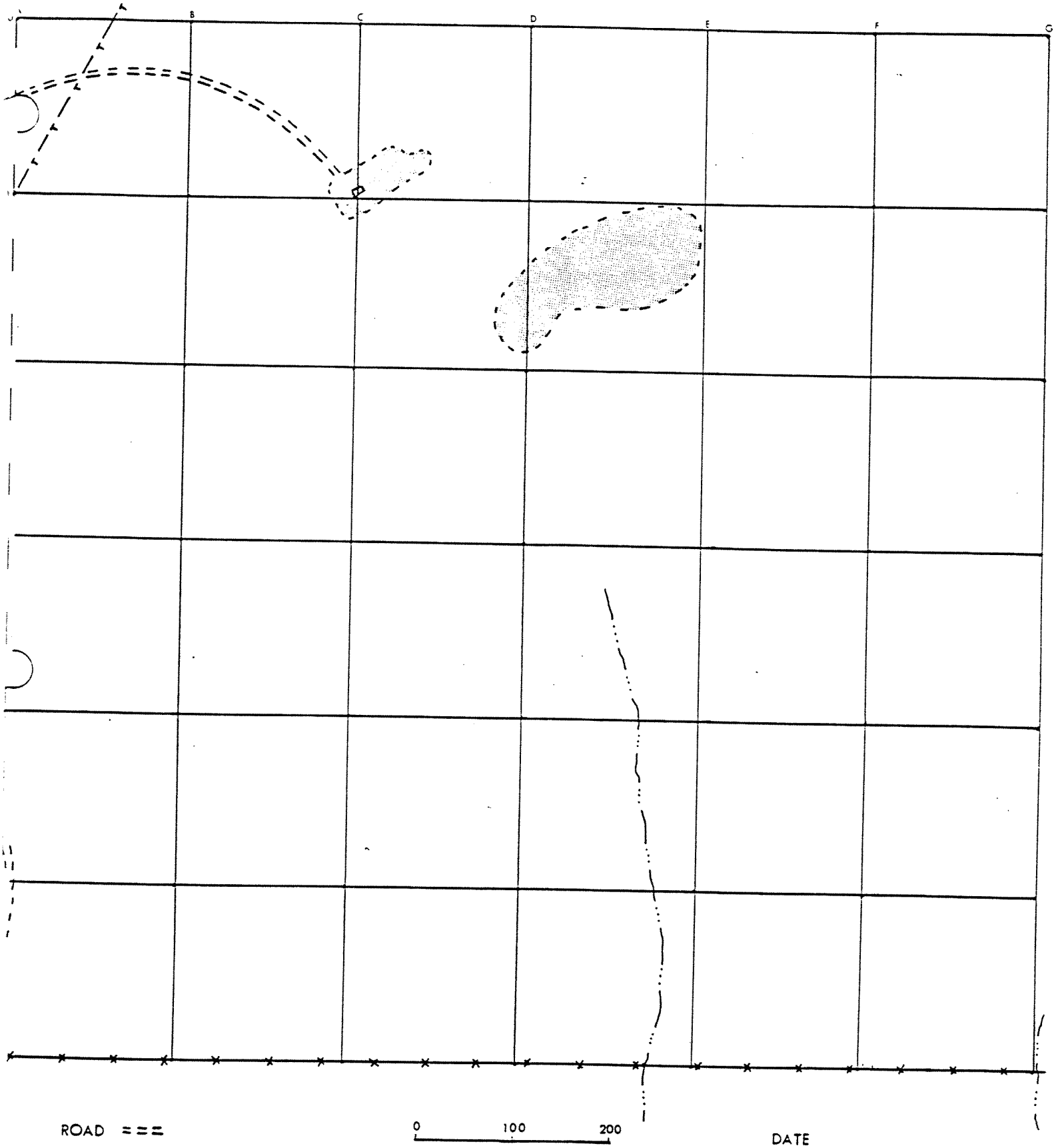
SG
PJ
CS
UF
MG-2
I-2
T-1
MG-1
A-2
Agriculture
A-1
Mill Tailings
36°42'30"
105°37'30"
S-1
R
R-2
GRANDE
RIO

CS
SG
S-2
SG
PJ-2
RJ
SG
CS-1
PJ
105° 37' 30"
36° 45'
UF
PJ
UF
PJ
SG
SG
PJ
UF
PJ
PJ
CS
PJ
SG
SG
UF
MG-2
SG
I-2
SG
A-2
Agriculture
PJ
T-1
UF
MG-1
SG
PJ
PJ
PJ
PJ
A-1

B.0 APPENDIX B - AVIAN CENSUS GRID MAPS



SAGEBRUSH/GRASSLAND



ROAD

FENCE

DRAINAGE

POWER LINE

AREAS WITHOUT TREE CANOPY

0 100 200

FEET

DATE

START TIME

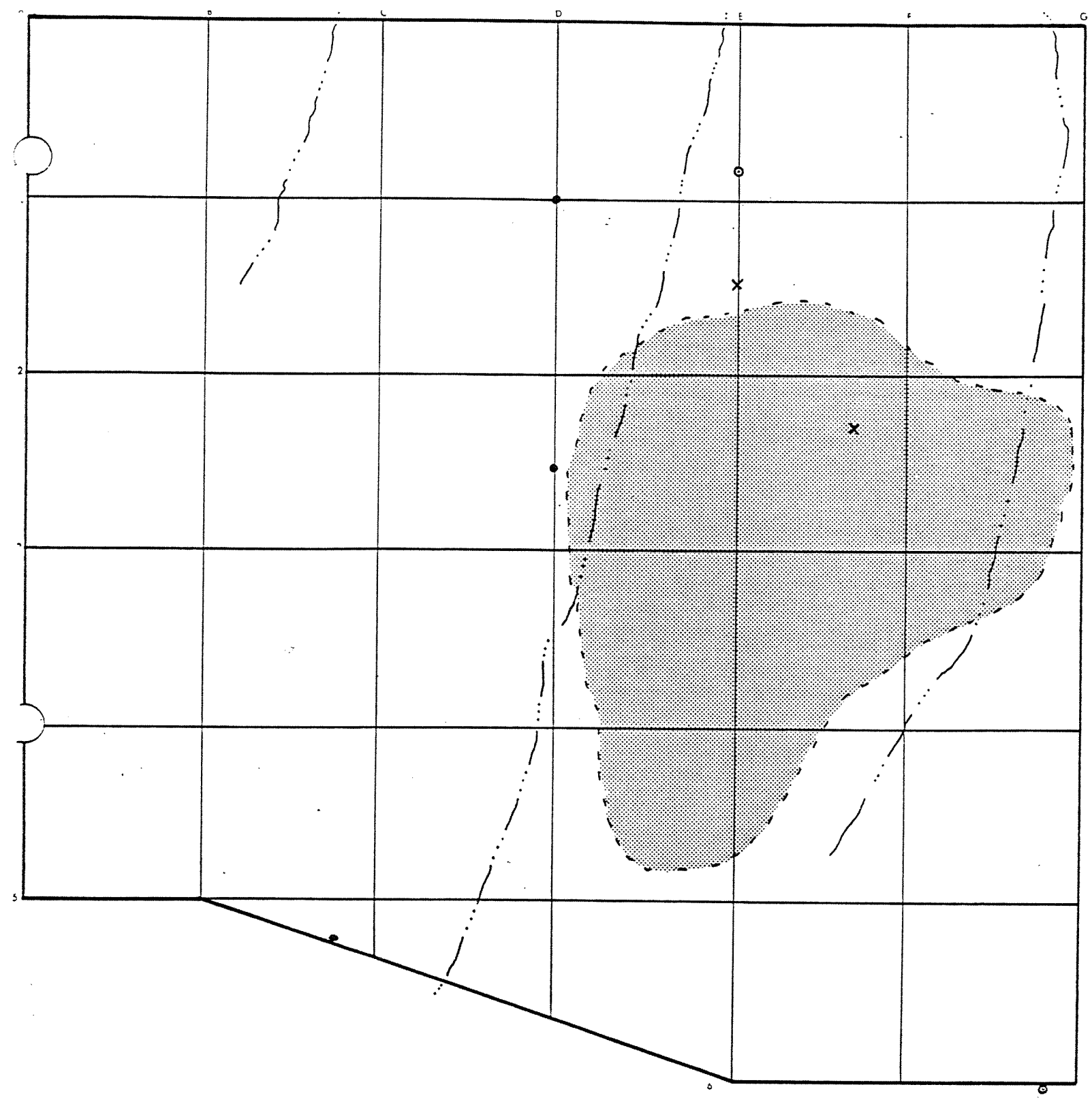
STOP TIME

TEMPERATURE

WIND

OBSERVER

PINON - JUNIPER WOODLAND



SNAG ×

DRAINAGE

QUARTER CORNER SECTIONS 26 & 27 ⊙

ISOLATED PONDEROSA •

FEW MATURE PONDEROSAS

0 100 200
FEET

DATE

START TIME

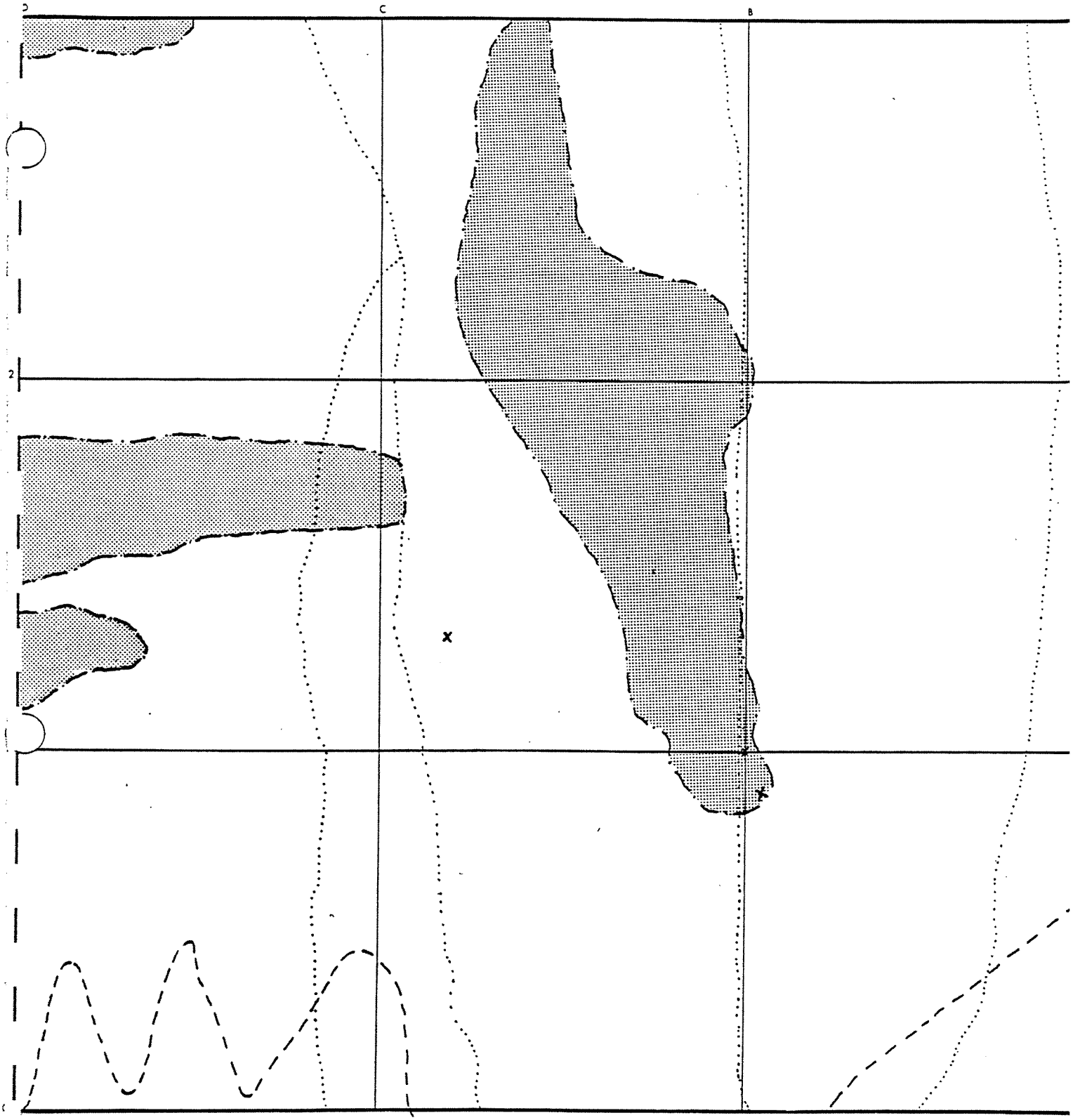
STOP TIME

TEMPERATURE

WIND

OBSERVER

UPLAND FOREST



TRAIL

SNAG x

BOULDER FIELD

BREAK IN SLOPE

0 100 200
FEET

DATE

START TIME

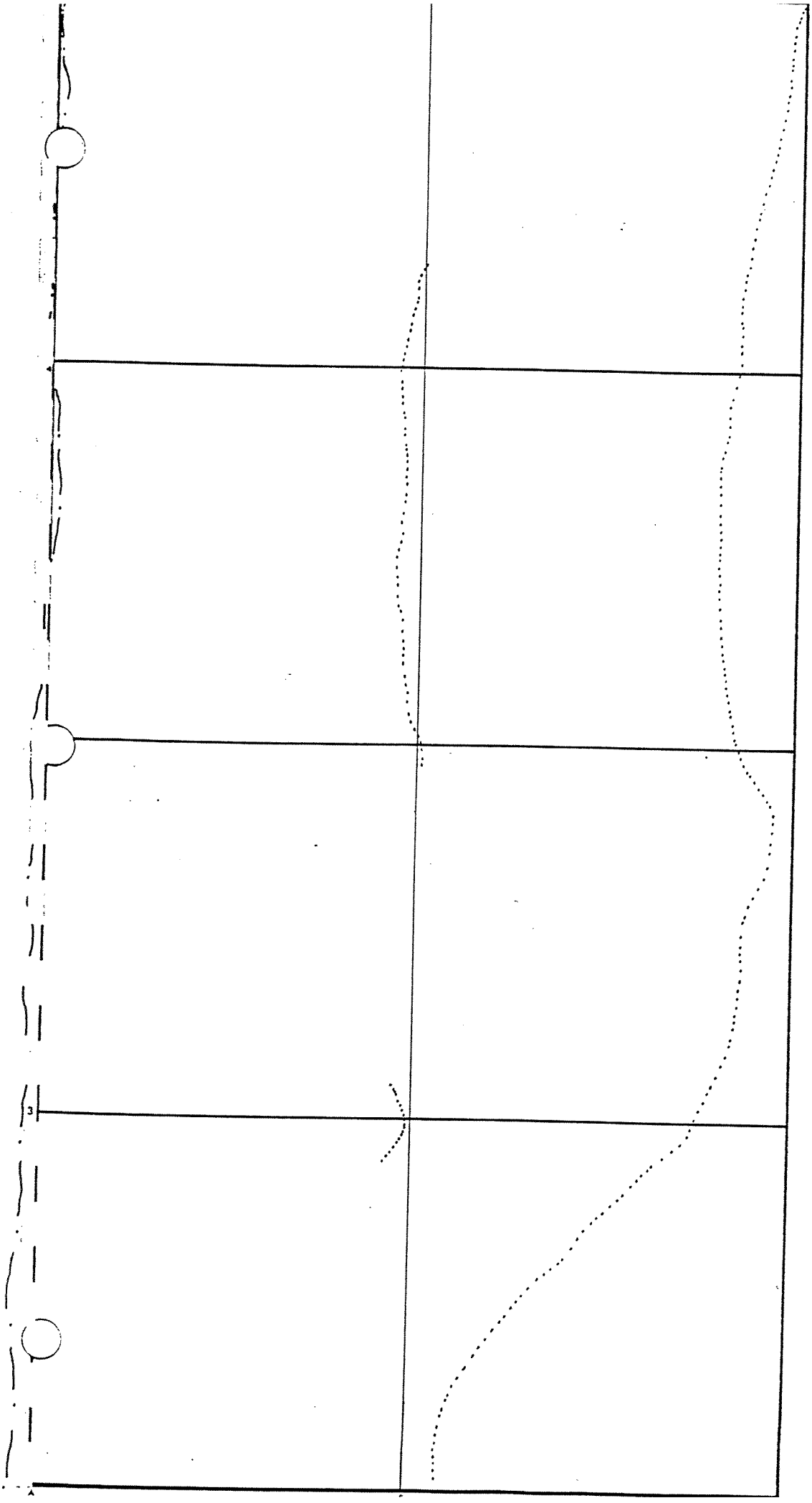
STOP TIME

TEMPERATURE

WIND

OBSERVER

WOODED CANYON BENCHES



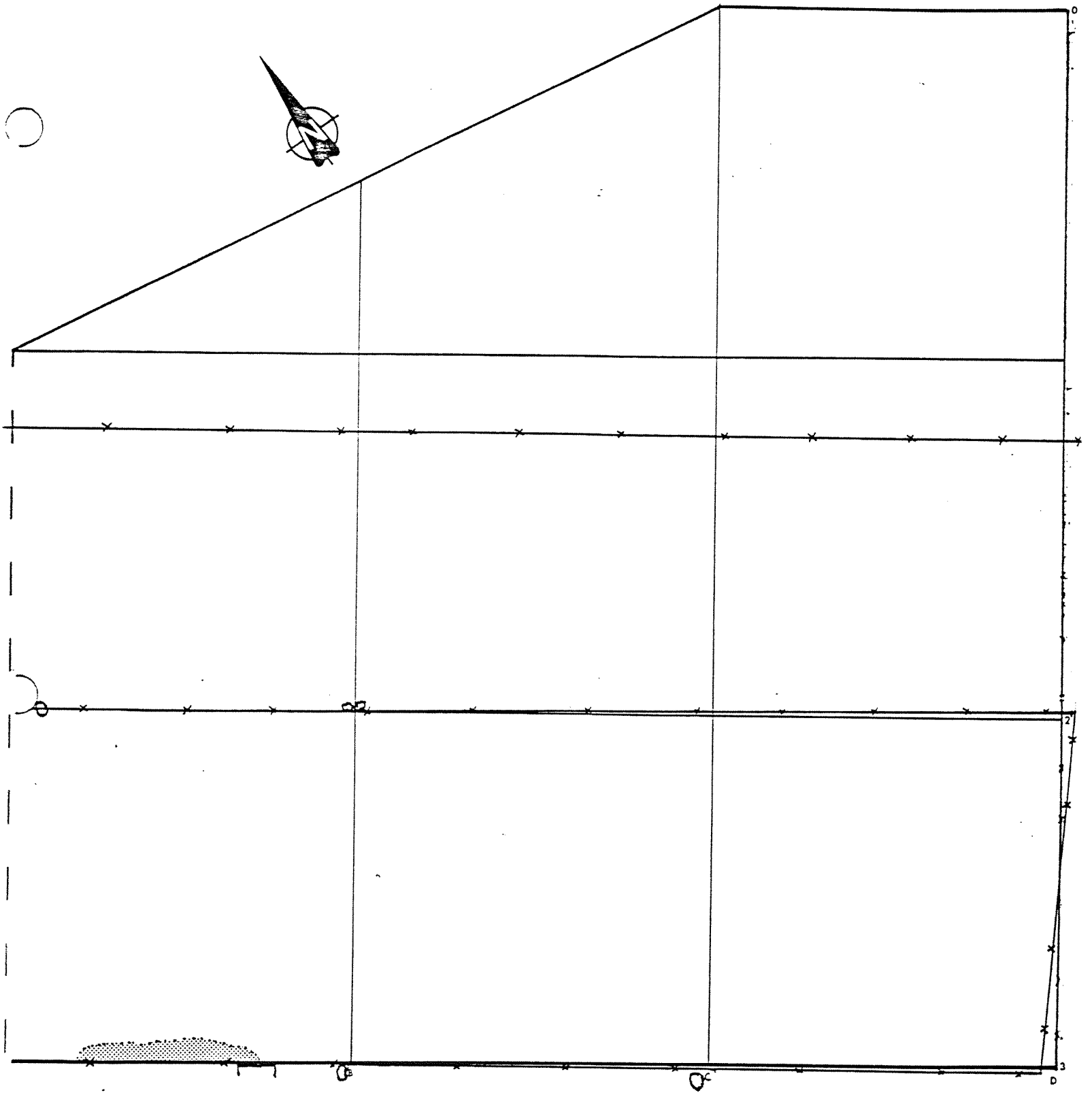
DATE
START TIME
STOP TIME
TEMPERATURE
WIND
OBSERVER

BREAK IN SLOPE
EAST BANK OF RIO GRANDE

N

0 100 200
FEET

CANYON SLOPES



FENCE

BRAMBLES

JUNIPER

SHED

0 100 200
FEET

DATE

START TIME

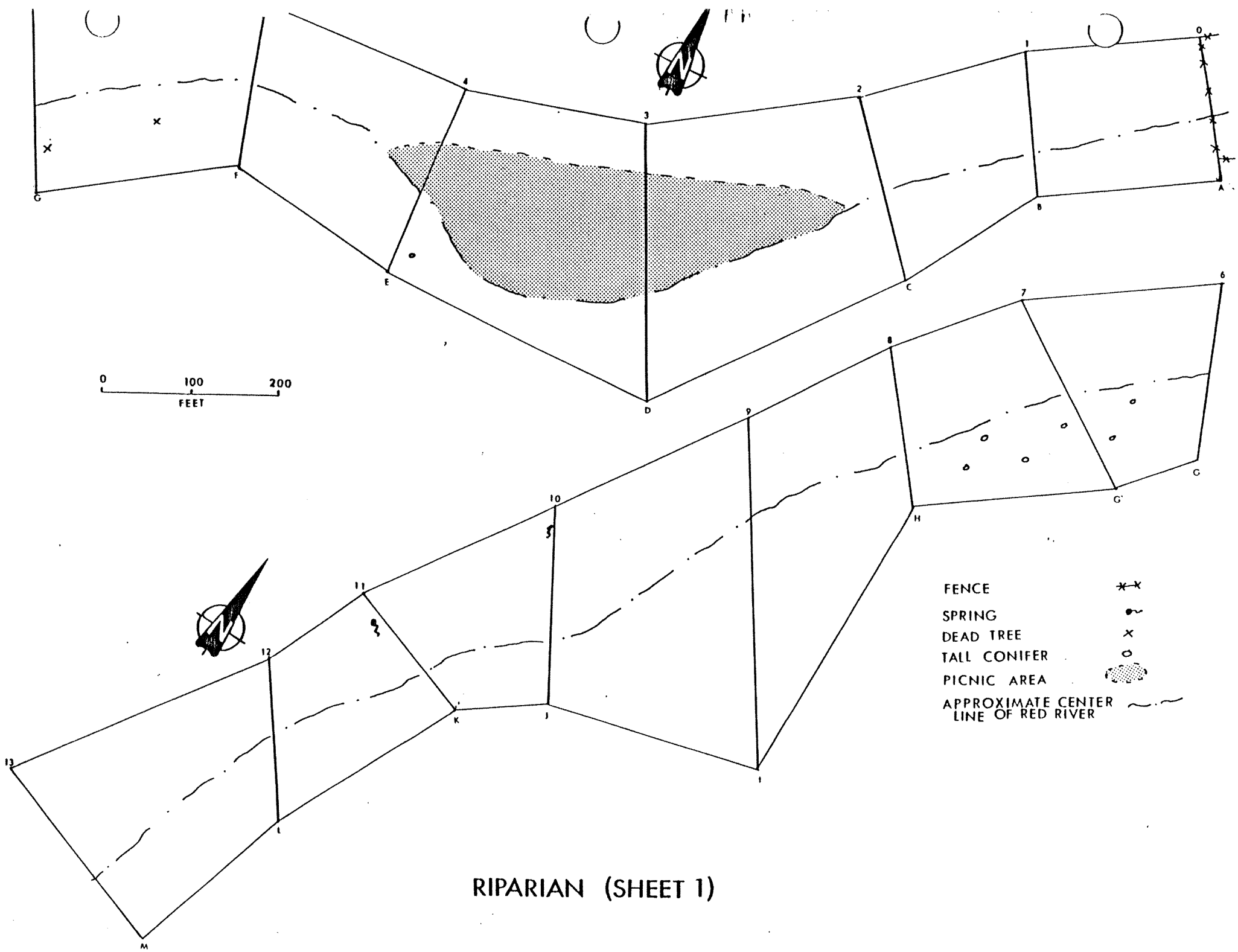
STOP TIME

TEMPERATURE

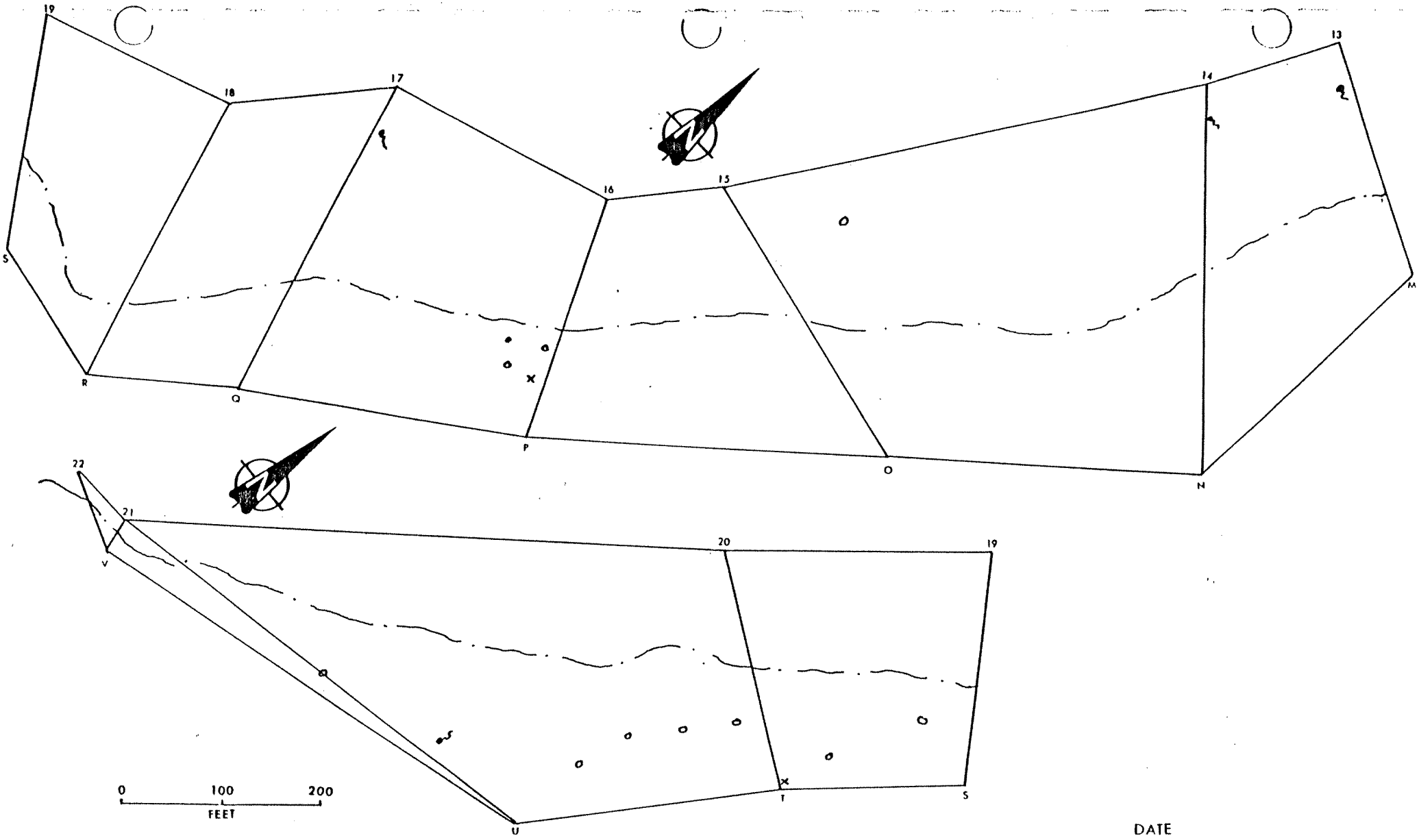
WIND

OBSERVER

AGRICULTURAL LAND



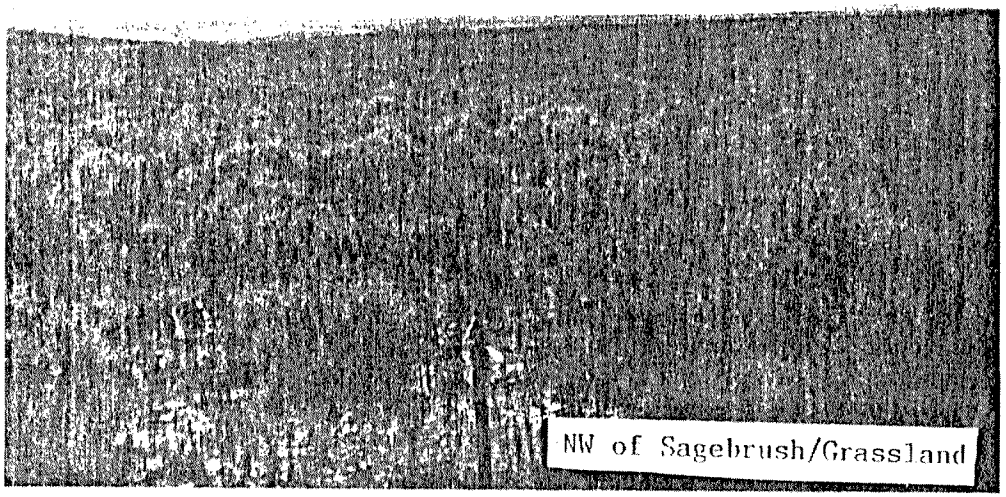
RIPARIAN (SHEET 1)

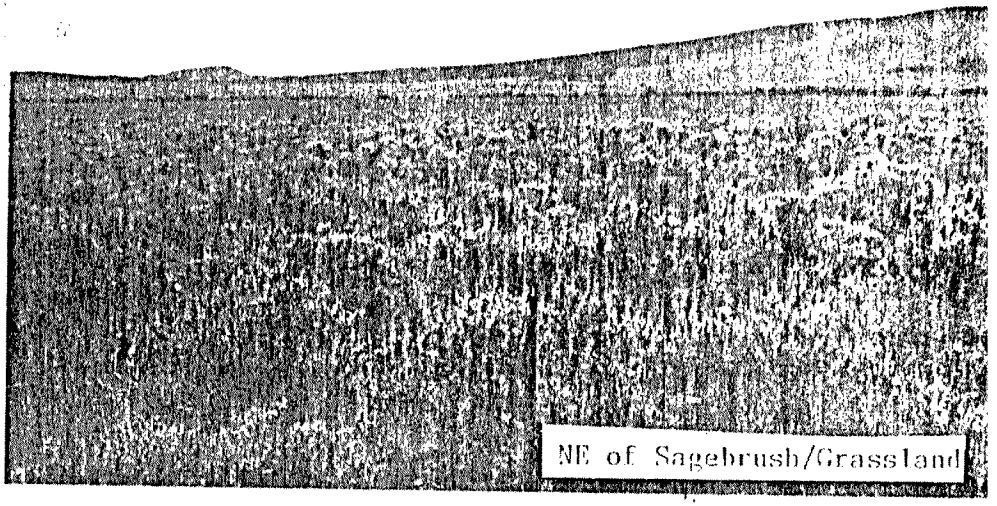


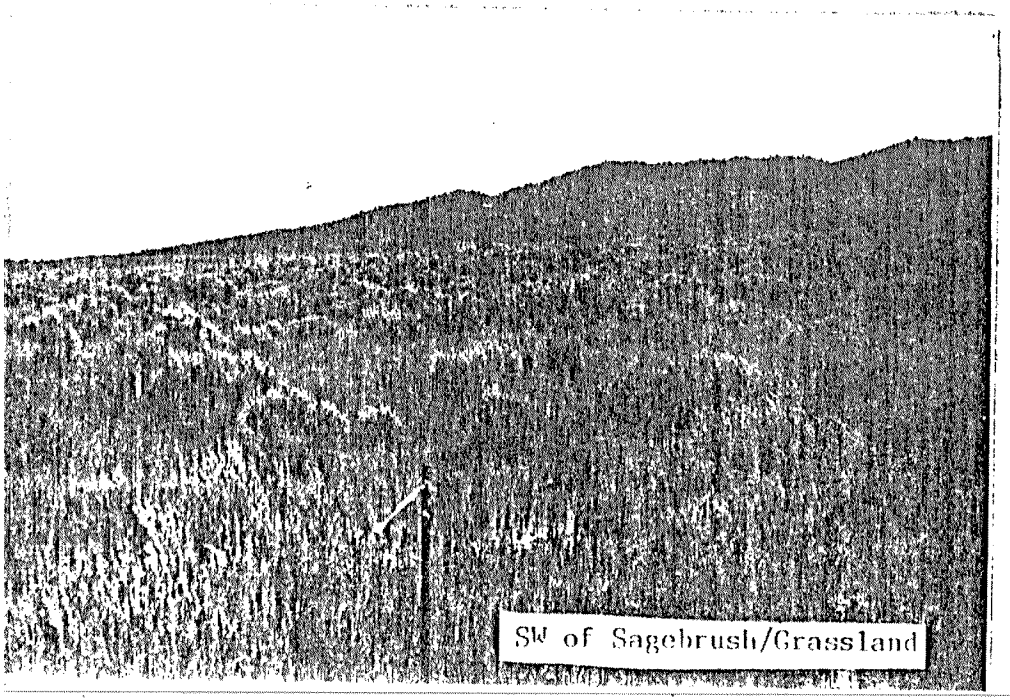
DATE
START TIME
STOP TIME
TEMPERATURE
WIND
OBSERVER

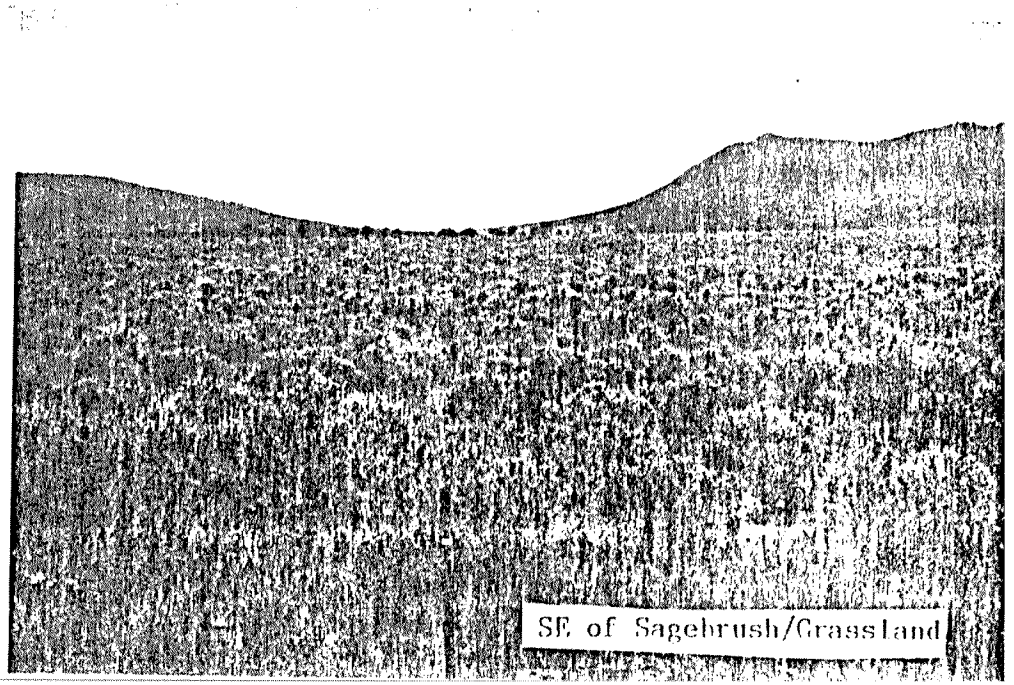
RIPARIAN (SHEET 2)

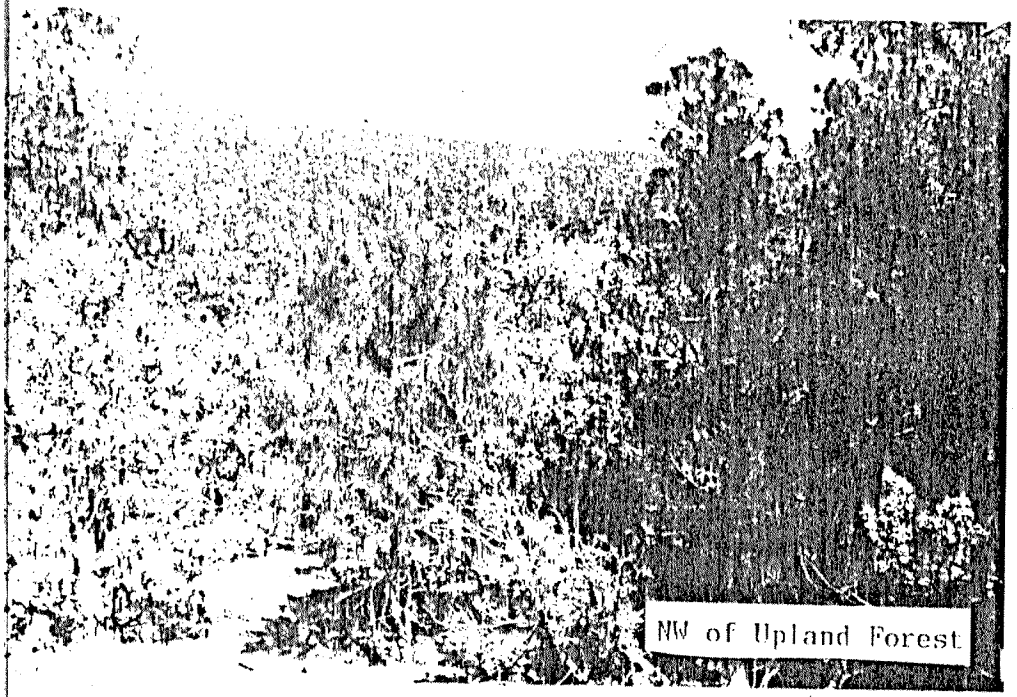
C.0 APPENDIX C - PHOTOGRAPHS AND SLIDES OF AVIAN CENSUS GRID MAPS


NW of Sagebrush/Grassland

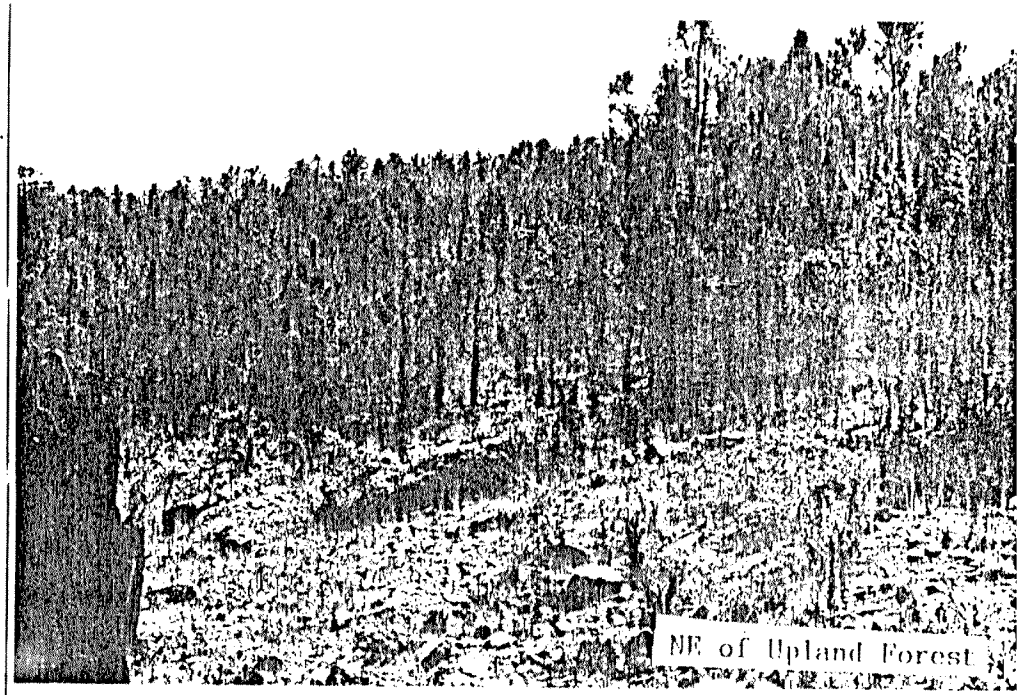

NE of Sagebrush/Grassland


SW of Sagebrush/Grassland

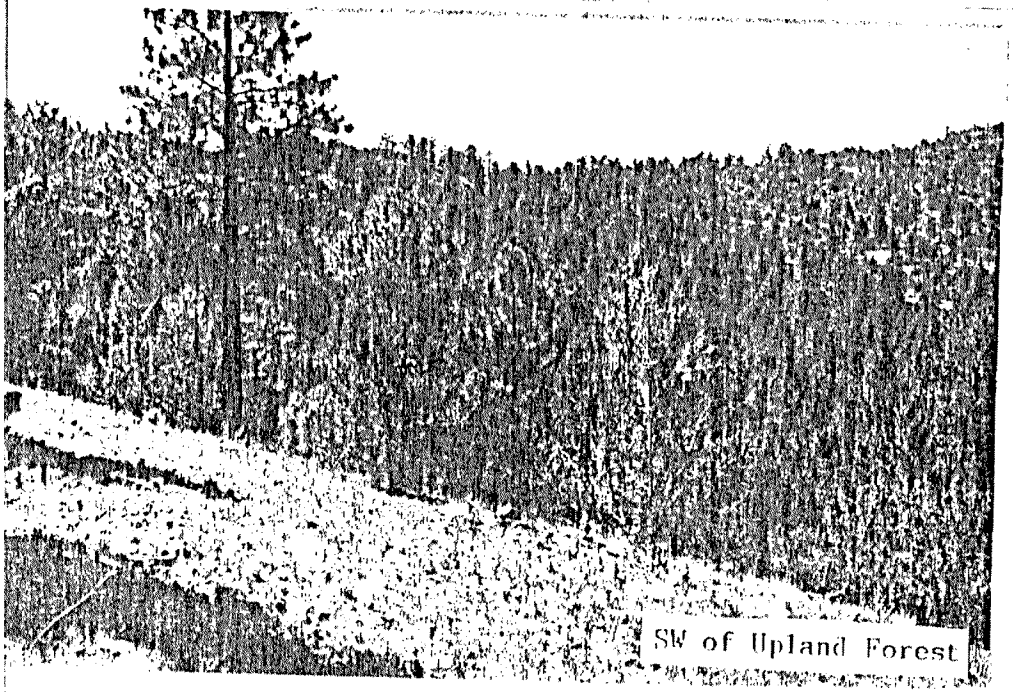

SE of Sagebrush/Grassland



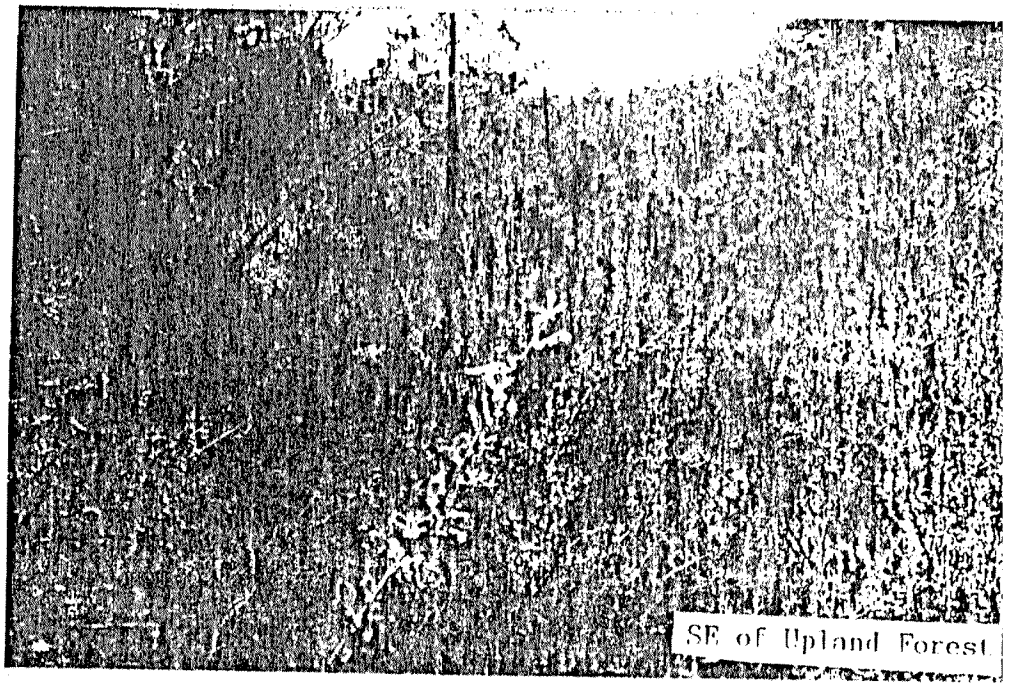
NW of Upland Forest



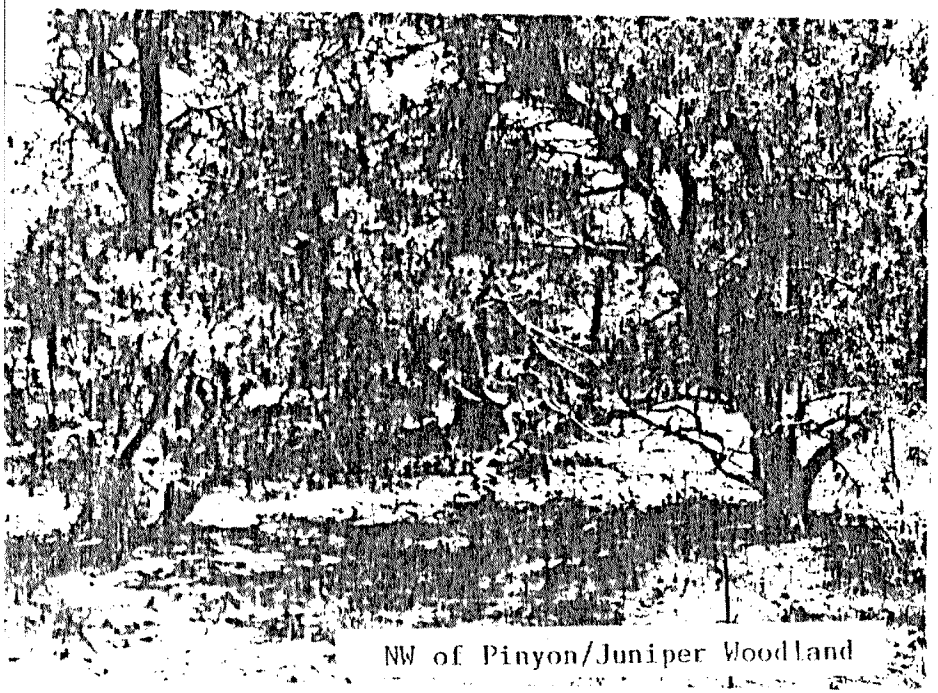
NE of Upland Forest



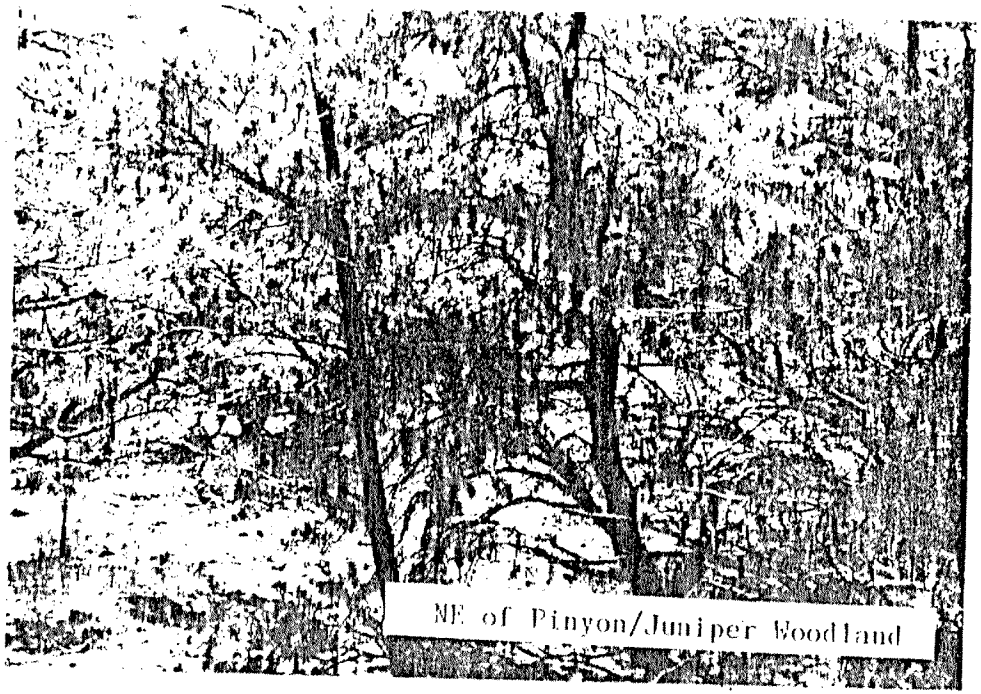
SW of Upland Forest



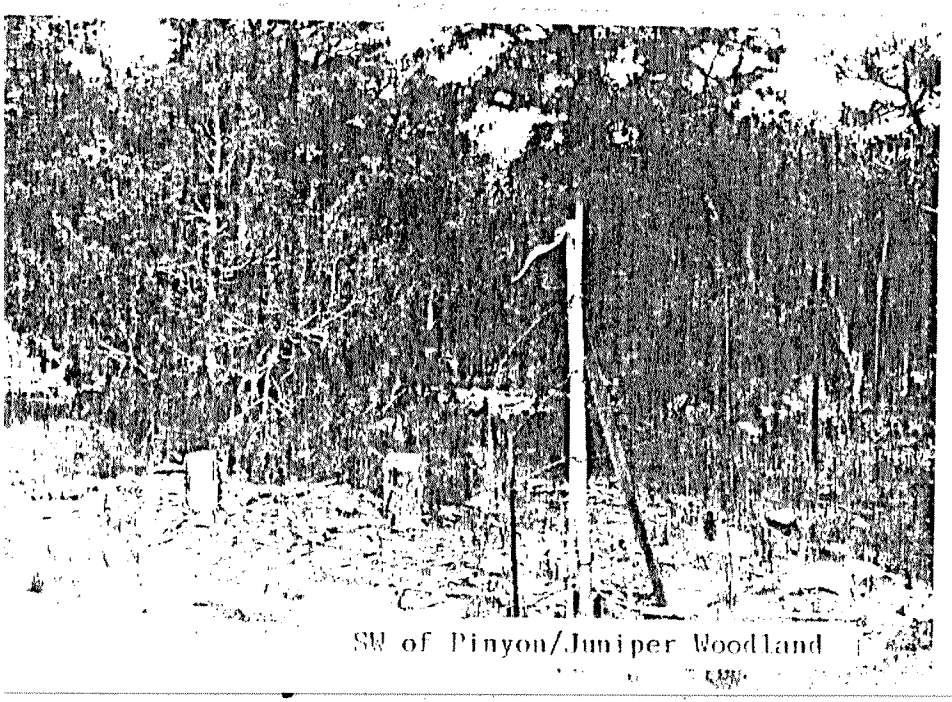
SE of Upland Forest



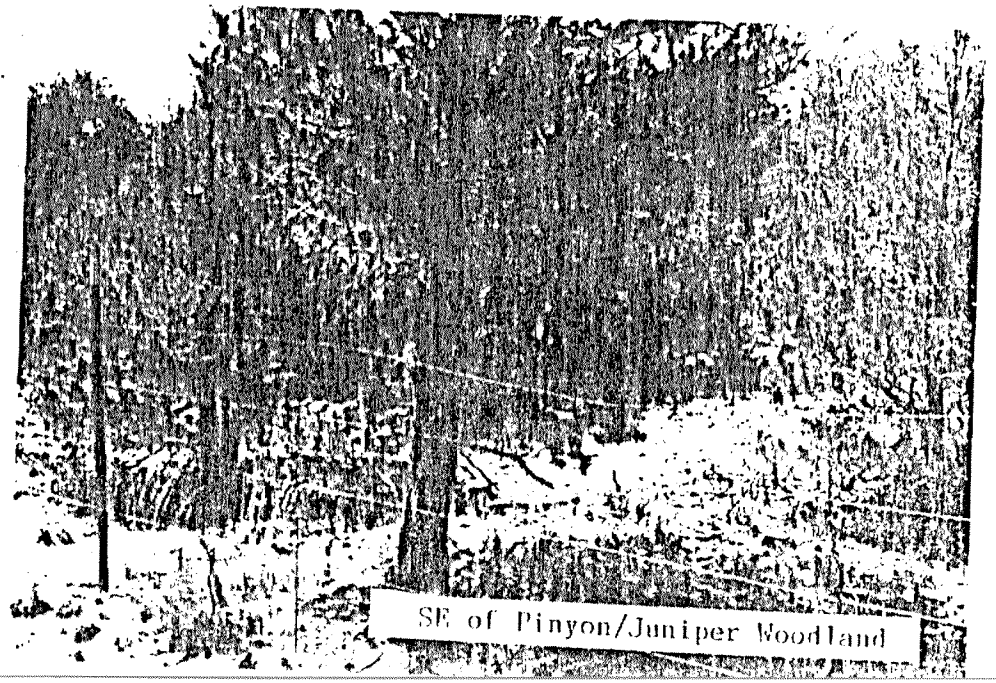
NW of Pinyon/Juniper Woodland



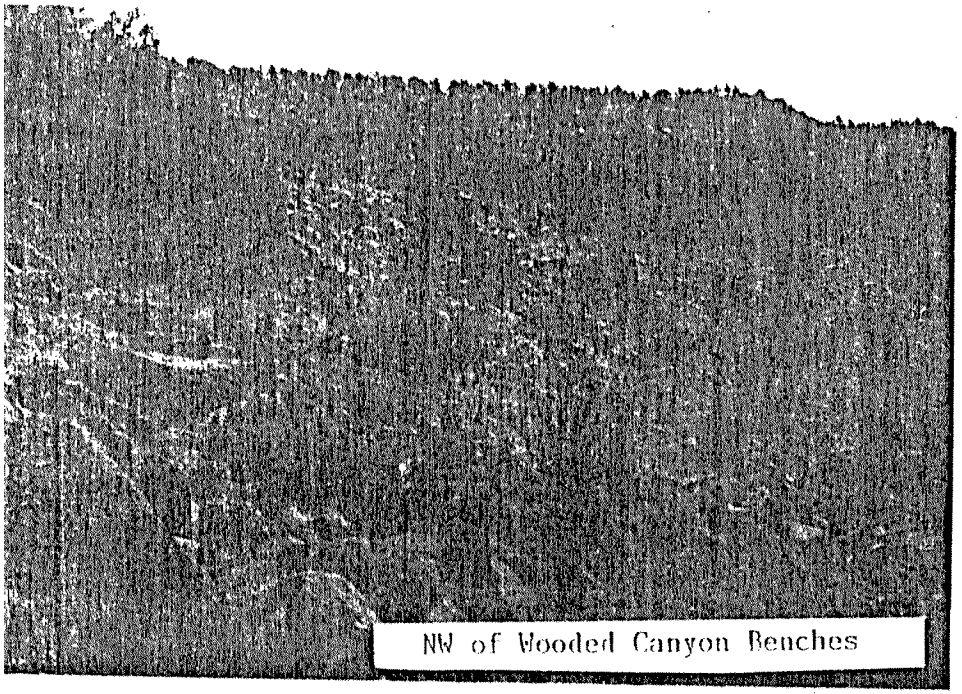
NE of Pinyon/Juniper Woodland



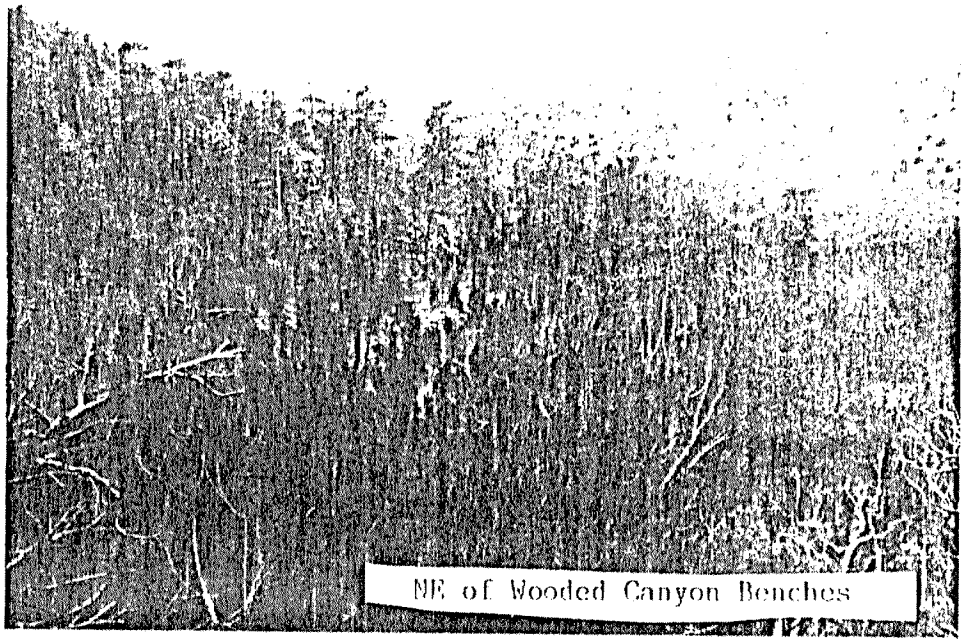
SW of Pinyon/Juniper Woodland



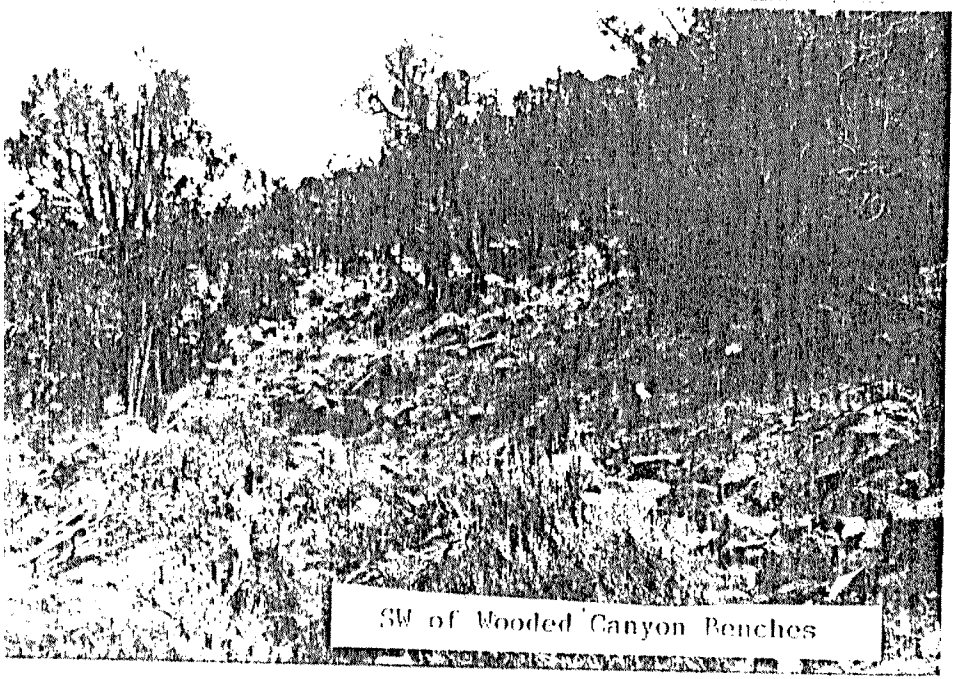
SE of Pinyon/Juniper Woodland



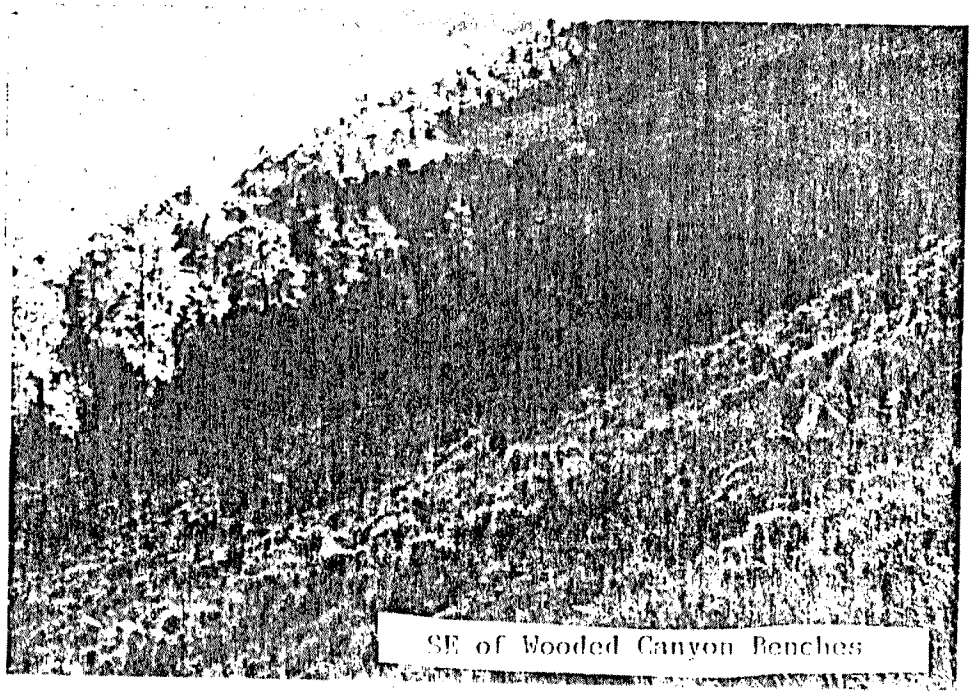
NW of Wooded Canyon Benches



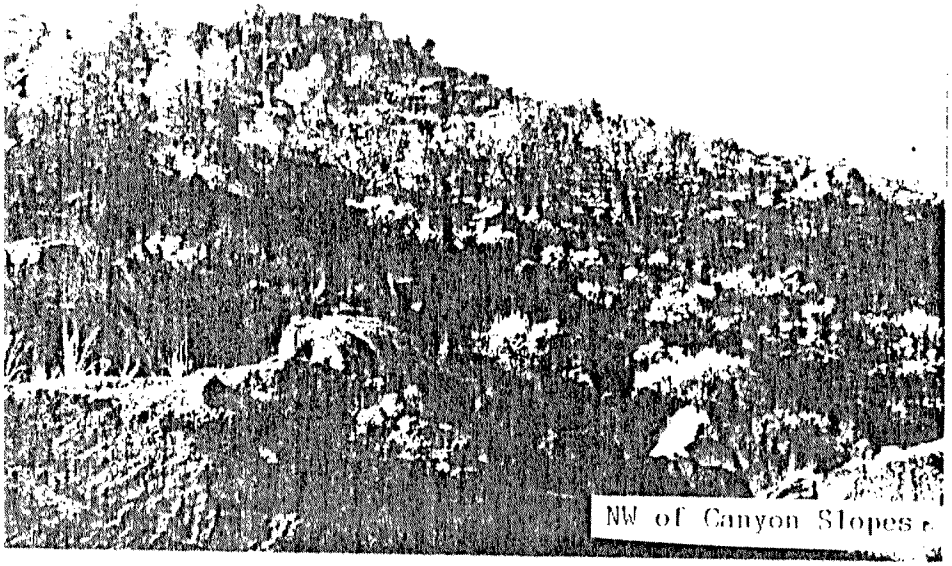
NE of Wooded Canyon Benches



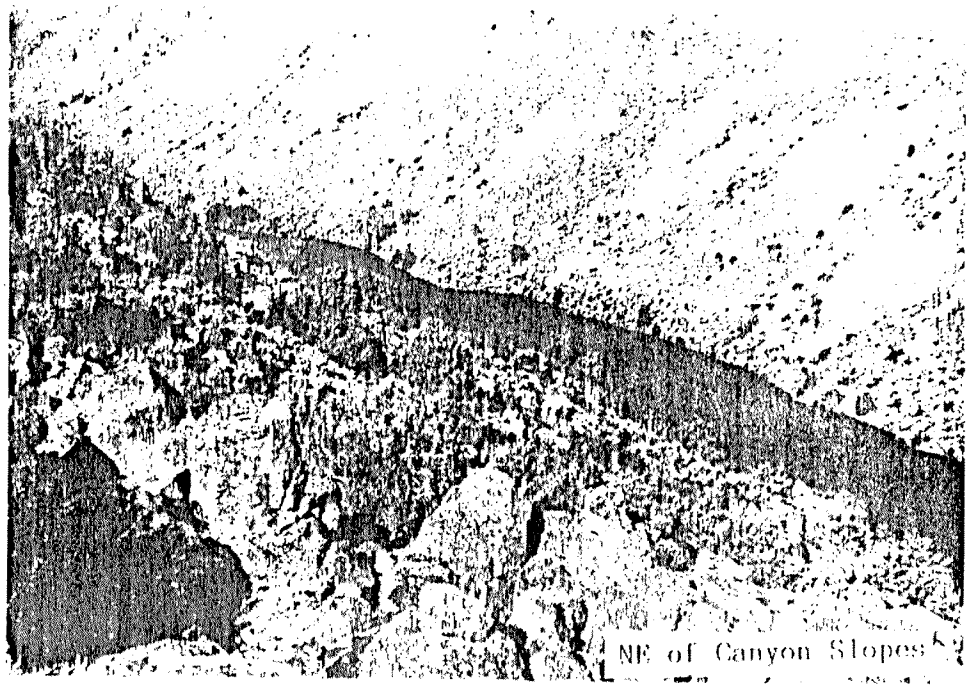
SW of Wooded Canyon Benches



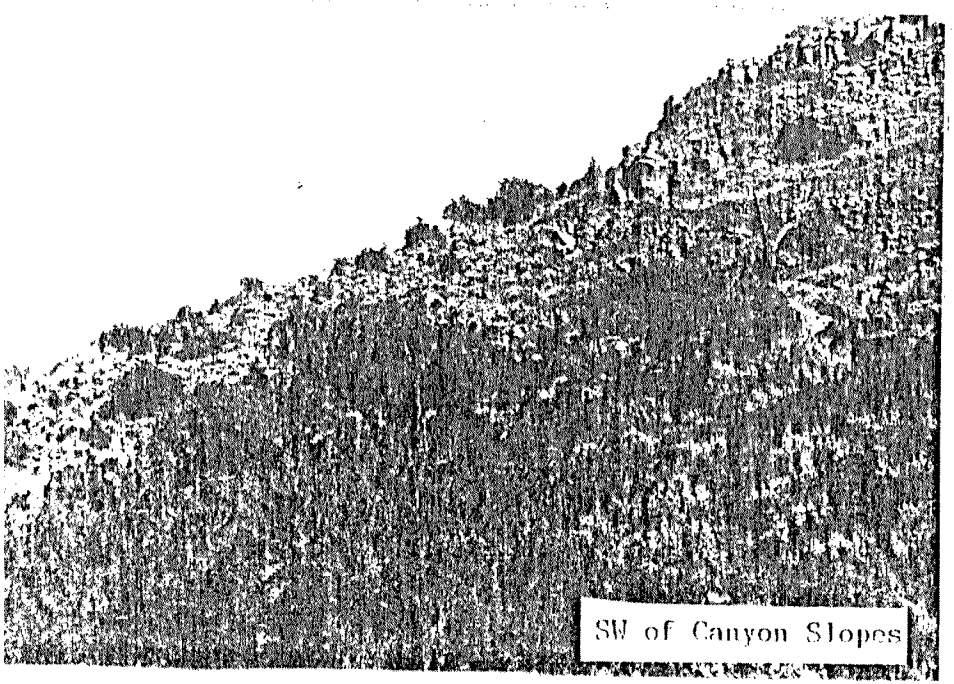
SE of Wooded Canyon Benches



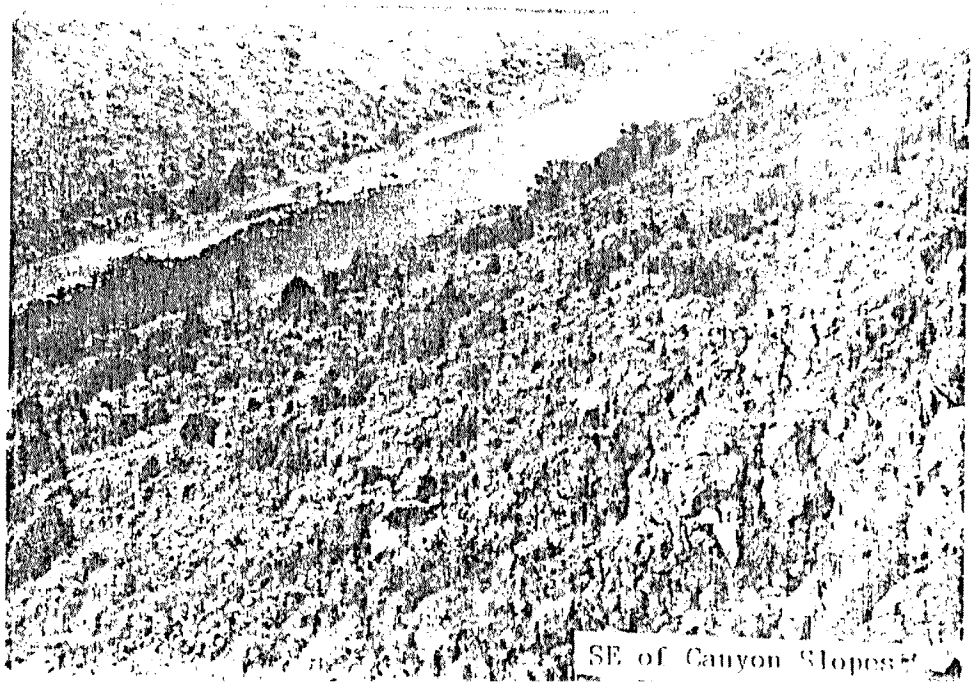
NW of Canyon Slopes



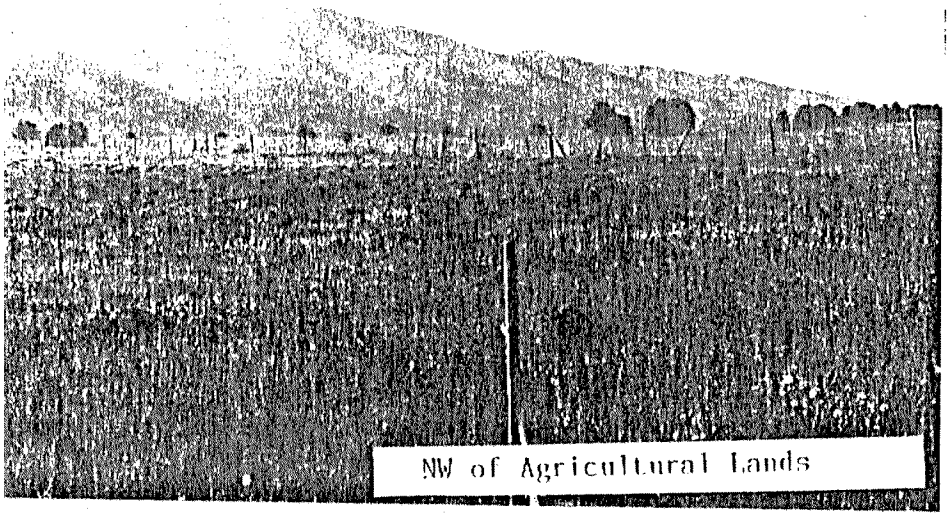
NE of Canyon Slopes



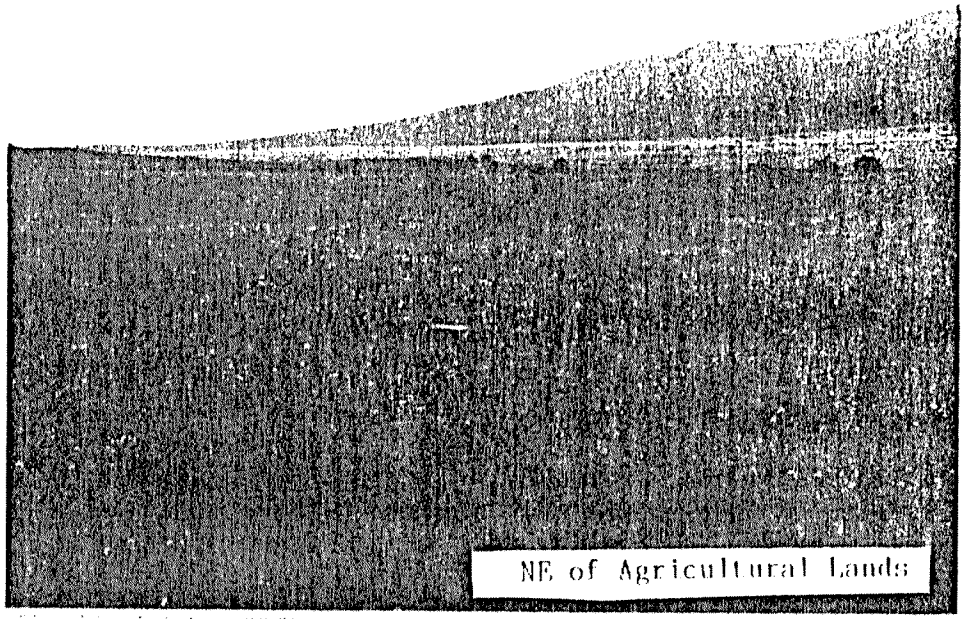
SW of Canyon Slopes



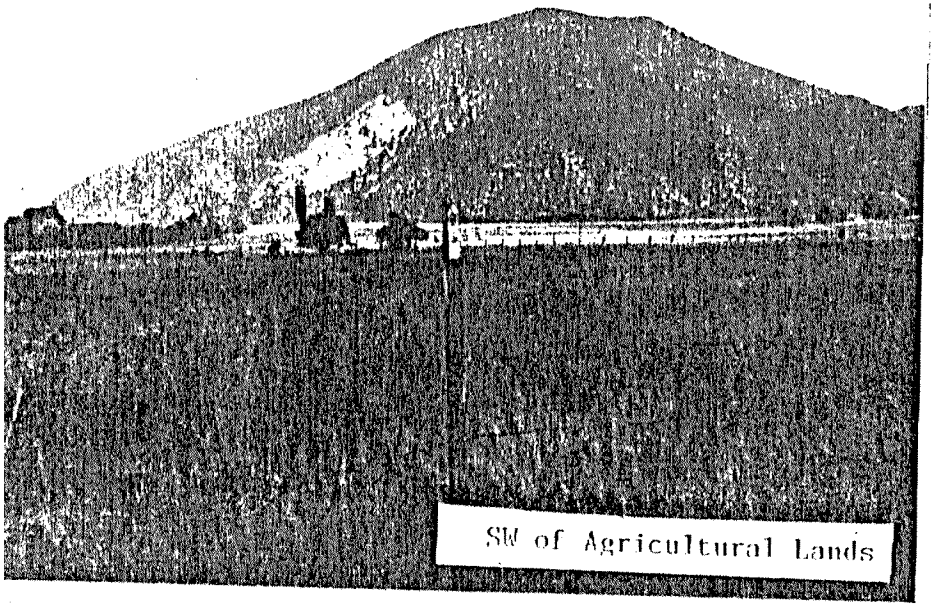
SE of Canyon Slopes



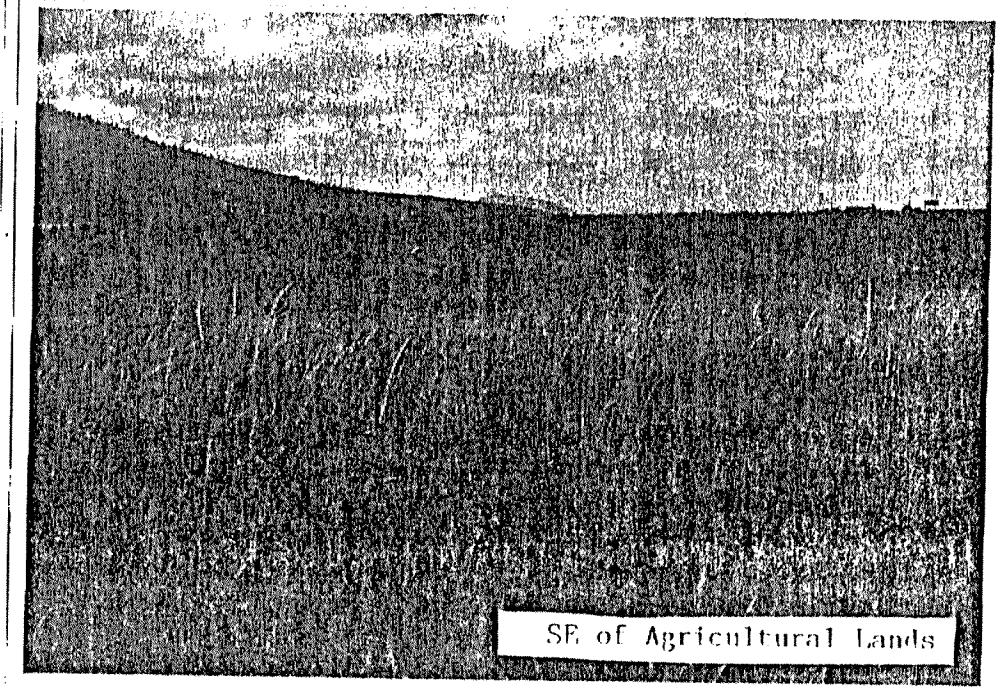
NW of Agricultural Lands



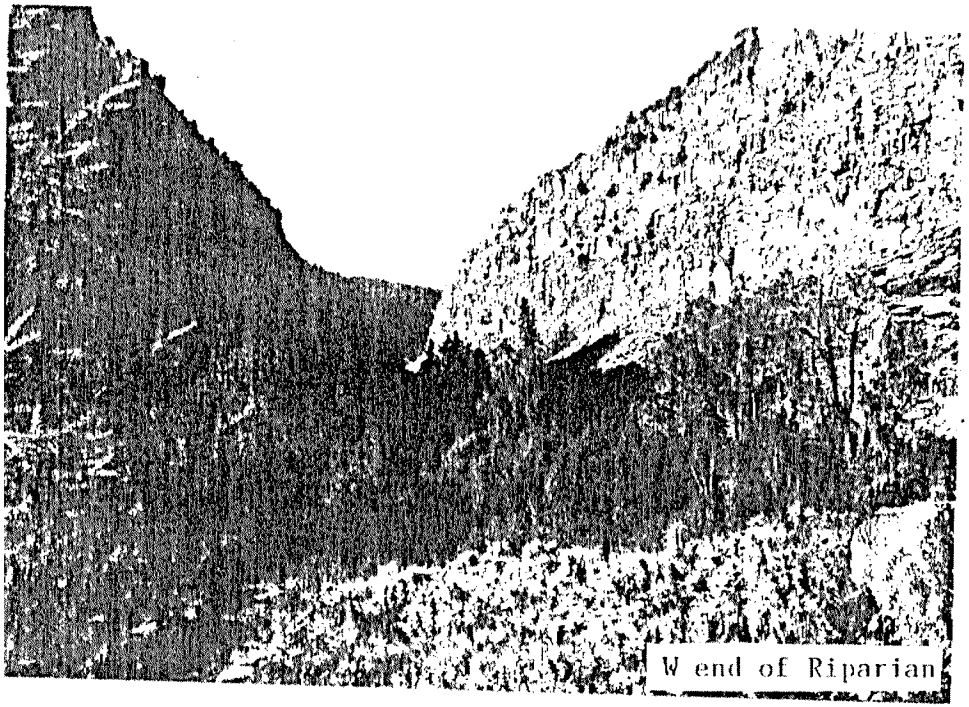
NE of Agricultural Lands

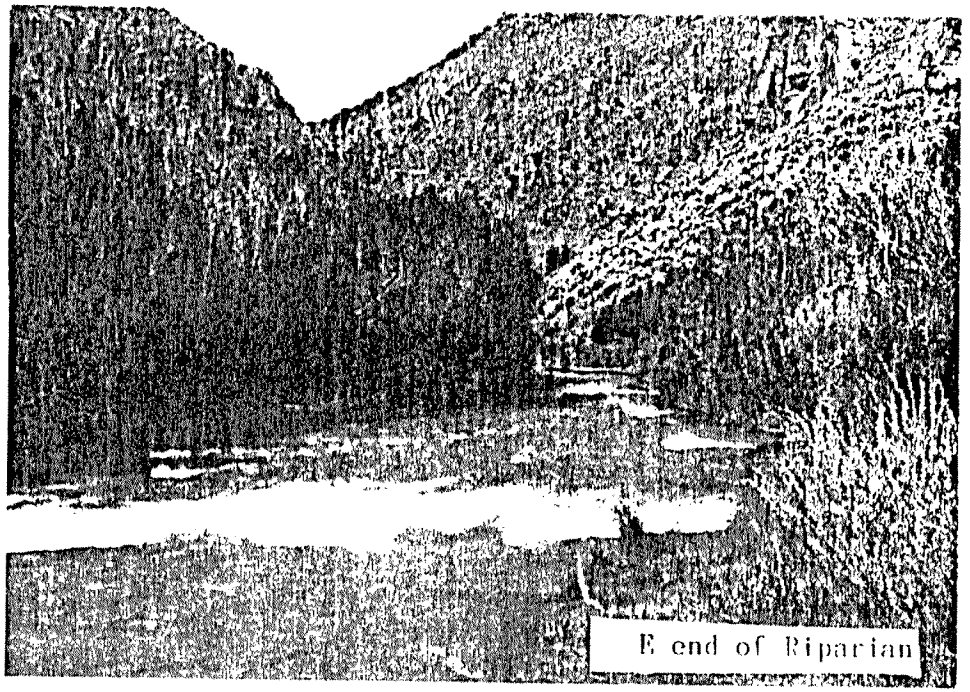


SW of Agricultural Lands



SE of Agricultural Lands


W end of Riparian


E end of Riparian

D.0 APPENDIX D - ADDITIONAL SPECIES OF BIRDS DOCUMENTED DURING STUDY

Appendix D. Avian species documented by Eagle Environmental, Inc. on the GMSA during this study, though not on an avian census grid.

Species	Date	Habitat Site	Relative Abundance	Status
Eared Grebe	various	Mill Tailings	U	T
White-faced Ibis	4-25-85	" "	U	T
Green-winged Teal	various	" "	C	T
Mallard	"	" "	SR	T
Blue-winged Teal	"	" "	C	T
Cinnamon Teal	5-27-85	" "	U	T
Northern Shoveler	various	" "	C	T
Gadwall	"	" "	C	T
American Wigeon	"	" "	C	T
Redhead	"	" "	C	T
Ring-necked Duck	"	" "	C	T
Lesser Scaup	5-27-85	" "	U	T
Hooded Merganser	5-16-85	" "	U	T
Ruddy Duck	various	" "	C	T
Sharp-shinned Hawk	9-14-84	Canyon Slopes	U	R
Northern Goshawk	5-09-85	Upland Forest	U	R
	6-09-85	" "		
Red-tailed Hawk	various	all	C	R
Golden Eagle	"	Sagebrush/Grass-land	U	R
Prairie Falcon	5-06-85	Sagebrush/Grass-land	U	R
American Coot	various	Mill Tailings	C	T
Semi-palmated Sandpiper	4-26-85	" "	U	T
Killdeer	various	" "	C	SR
American Avocet	"	" "	C	T
Greater Yellowlegs	5-16-85	" "	U	T
Willet	various	" "	U	T
Spotted Sandpiper	"	" "	C	SR
Marbled Godwit	"	" "	U	T
Long-billed Dowitcher	5-09-85	" "	U	T
Common Snipe	various	" "	U	T
Wilson's Phalarope	"	" "	C	T
Ring-billed Gull	"	" "	C	SR
Flammulated Owl	6-21-85	Upland Forest	U	SR
Western Screech Owl	9-15-84	Pinyon/Juniper Woodland	U	SR
Burrowing Owl	4-25-85	Sagebrush/Grass-land	U	SR
Common Poorwill	5-17-85	Pinyon/Juniper Woodland	U	SR
Belted Kingfisher	various	Riparian	U	R
Lewis' Woodpecker	4-25-85	Agricultural Lands	U	R
Western Flycatcher	5-28-85	Pinyon/Juniper Woodland	U	SR
Eastern Kingbird	6-04-85	Agricultural Lands	U	SR
Tree Swallow	various	Mill Tailings	C	T

Appendix D. (Concluded).

Species	Date	Habitat Site	Relative Abundance	Status
Northern Rough-winged Swallow	"	" "	C	T
Blue-gray Gnatcatcher	5-28-85	Pinyon/Juniper Woodland	U	SR
Hermit Thrush	various	Pinyon/Juniper Woodland	U	SR
Northern Mockingbird	4-24-85	Sagebrush/Grassland	U	R
Grace's Warbler	various	Upland Forest	U	SR
Hepatic Tanager	5-29-85 6-07-85	Wooded Canyon Benches	U	SR
Rose-breasted Grosbeak	5-16-85	Canyon Slopes		
Lesser Goldfinch	8-23-84	Pinyon/Juniper Woodland	U	SR

Abundance Categories

A - species is almost always seen in large numbers.
C - species is usually seen in numbers in suitable habitat.
U - species is not often seen but is not out of range.
R - species is very infrequently seen in the study area or is out of normal range.

Status Categories

R - species is resident in study area year-round.
SR - species is resident only during summer; often a breeding species.
T - species only occurs in study area during periods of spring or fall migration; or a wandering species.