CHAPTER 10

FISH AND WILDLIFE RESOURCES

CHAPTER 10

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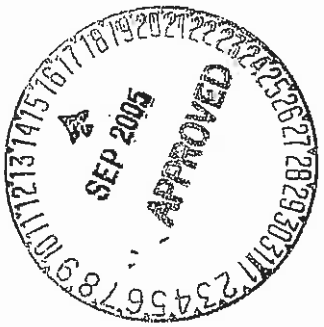
Attachment 5. Biological Information, References, and Future Monitoring Efforts For the N9 Coal Resource Area, Black Mesa Mining Complex



CHAPTER 10

FISH AND WILDLIFE RESOURCES

Introduction

Peabody Coal Company (PCC) began an ongoing fish and wildlife monitoring program in 1979. The program was designed in consultation with the Office of Surface Mining, the Navajo Tribe and Espey, Huston and Associates, Inc. (EH&A), of Austin, Texas. The major objectives of the program are to: (1) develop qualitative and quantitative baseline information concerning the fish and wildlife which inhabit the Black Mesa leases and surrounding area; (2) develop information useful for assessing the impacts of surface mining and reclamation on the existing fauna; (3) develop procedures for minimizing or preventing impacts and enhancing wildlife habitat in the postmining landscape; and (4) document the existence of wildlife in the postmining landscape.

The baseline fish and wildlife studies have progressed in three phases (Figure 1). The initial baseline studies, completed in 1980, were conducted in the western and northeastern portions of the leasehold. Quantitative and qualitative fish and wildlife sampling and habitat assessments were conducted by EH&A during October, 1979, and April, May and July of 1980. The results of these studies were presented in a report prepared for Peabody (EH&A 1980), which accompanies the Mining and Reclamation Plan submitted in January, 1981.

The baseline studies were continued in 1981, in the region of the leasehold which contains the J-16 and J-28 mining areas (Figure 1). These studies were conducted by Peabody biologists. The results were presented in the Vegetation and Wildlife Resources 1981 Report for the Black Mesa and Kayenta Mines (Arizona Division, PCC 1982).

Fish and wildlife baseline studies were continued in 1982 and 1983 in the region of the leasehold which contains the contiguous J-19, J-20, J-21 and J-23 mining areas (Figure 1). The results of these studies, also conducted by Peabody biologists, were submitted as part of a mine plan modification filed with regulatory authorities in July, 1983.

Additional wildlife studies have been conducted to fill perceived gaps in the data base or

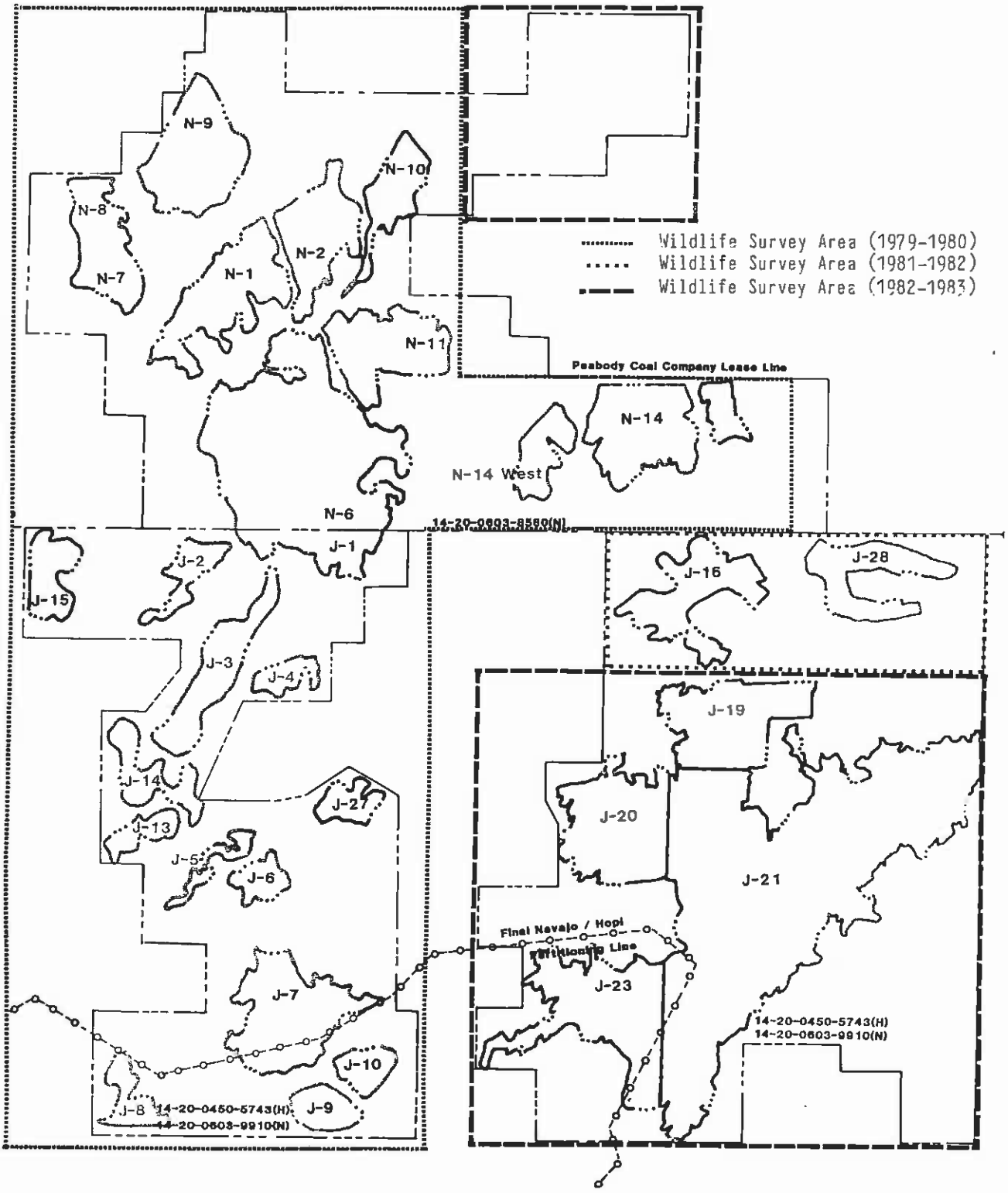


Figure 1

Black Mesa Leasehold Wildlife Study Areas

at increased levels of intensity because of the nature of the wildlife group involved. Qualitative studies were conducted in the mixed conifer woodland habitat to the north of the leasehold. A detailed census of waterfowl and shorebirds, started in 1982 by Peabody biologists, was completed in 1983. The results of this study were reported in the Vegetation and Wildlife Resources 1983 Report for the Black Mesa and Kayenta Mines (Arizona Division, PCC 1984). Raptor nesting surveys were started in 1982 and are ongoing annually. The monitoring data collected to 1984 were presented along with the results of other monitoring activities in the Vegetation and Wildlife Resources 1984 Report (Arizona Division, PCC 1985). Since 1984 wildlife monitoring results have been reported to OSMRE on an annual basis. Additionally, wildlife studies were conducted in the remaining Black Mesa leasehold life of mine coal resource areas (LOMCRA) in 2003, including N99 and N9. Studies for N99 and N9 can be found in Attachments 4 and 5.

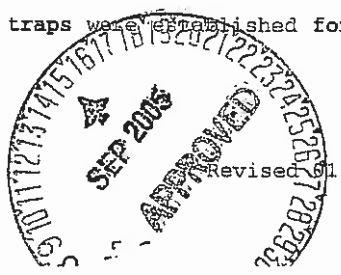
The objective of this chapter is to provide a detailed description of the fish and wildlife and their habitats within and surrounding the Black Mesa leasehold. This necessitated consolidation of information that had been collected over a period of six years. See Attachment 1 for a subject reference listing of this information.

The following sections present: (1) a review of the fish and wildlife sampling methods; (2) a description of the fish and wildlife resources and their habitats; (3) a discussion of wildlife groups of special interest; (4) a discussion of critical habitats; (5) impact analysis; and (6) procedures for minimizing or reducing impacts.

Methods and Materials

Qualitative and quantitative surveys of amphibians, reptiles, birds and mammals have been conducted in and surrounding the leasehold since 1979, involving a number of consultants and investigators. Sampling was conducted in each habitat that has been identified on the leasehold. The level of sampling intensity was based upon the degree of impact expected in each habitat. For example, the sagebrush shrubland and pinyon-juniper habitats received concentrated efforts because they are the primary habitats being disturbed. The sampling methods are presented below for each wildlife group.

Reptiles and Amphibians. Quantitative sampling of these vertebrate classes was conducted by EH&A biologists using pit-traps, general field reconnaissance and observation, and listening for vocalizations at appropriate times (EH&A 1980). Paired pit-fall traps were established for four to six days in each habitat type. All additional information on



these groups was collected as observational records kept during field activities conducted by Peabody biologists since the spring of 1982.

Birds. Avian species were sampled using daily and seasonal field observation, variable width transects (Emlen 1971, 1977), spot-map censuses (Kendeigh 1944) and road cruise counts of relative frequency (EH&A 1980).

The total number of each avian species observed and the mileage traveled was recorded daily as on-site surveys were conducted by EH&A in 1979 and 1980. Results were expressed as the total number of each species observed and the number of each species observed per distance traveled, seasonally. Incidental bird observation records have been kept by Peabody biologists since 1982. Notes are kept in a manner which provides insight into the timing and dynamics of migration, breeding activities, habitat preferences, foraging behavior and response to mining activities.

Twice each season, a road cruise census was made over a route encompassing all habitat types represented in the particular area being surveyed. The length of the route was determined by the size of the sample area. Three-minute stops to record bird detections were made at 0.8 kilometer intervals. Results were expressed as the percent of station stops at which each species was observed (frequency) and number of birds observed per mile along the route (abundance). Three routes were established to perform the cruise censuses (Figure 2). EH&A biologists drove a 32.18 kilometer route throughout the western and northeastern portion of the leasehold. Peabody biologists drove a 16.1 kilometer route in the area around the J-16 and J-28 mining areas and throughout the contiguous J-19, 20, 21 and 23 mining areas.

Seasonal variable strip censuses were conducted in the principal habitat types in the survey areas to determine bird densities. The transects were 1,500 meters in length and were traversed three times each season. Habitats which have been censused include the sagebrush shrubland, saltbush shrubland, sagebrush-mixed shrub (rabbitbrush) shrubland, tamarix riparian strand, greasewood shrubland, pinyon-juniper woodland and sagebrush/pinyon-juniper transition (Figure 2). Results are expressed as numbers per 40 hectares.

Spot-map censuses of three stands of pinyon-juniper woodland in the vicinity of the contiguous through 23 mining areas were conducted in 1983 and 1984 (Figure 2).

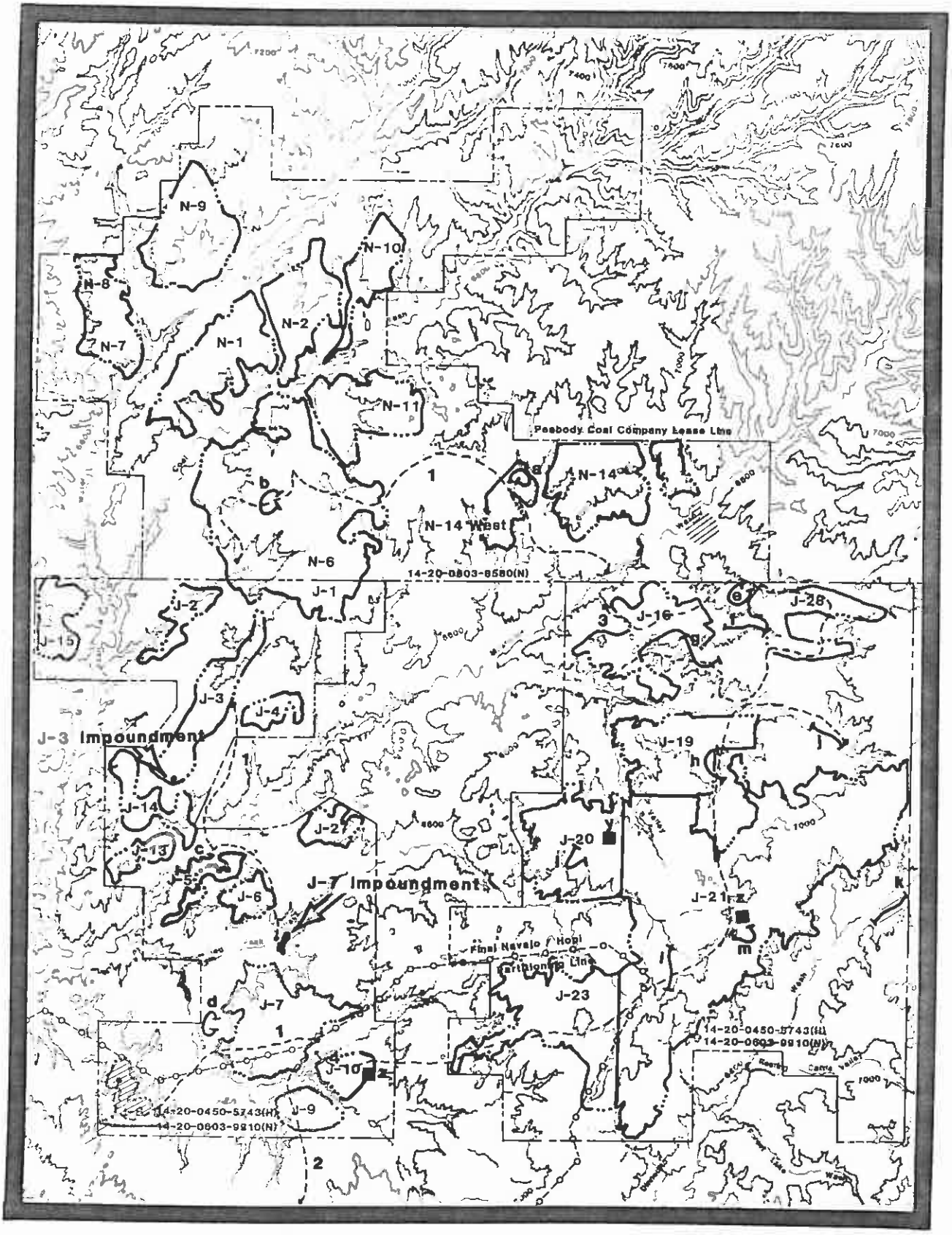


Figure 2
Wildlife Sampling Sites on the Black Mesa Leasehold

LEGEND (Figure 2 Cont.)

Mining Area

Road Cruise Routes (Bird, Spotlight and Scent Stations)

1 = 1979-80

2 = 1979-80 alternate

3 = 1981-82

4 = 1982-83

Variable Width Bird Density and Small Mammal Trapping Transects

a = 1979-80 Pinyon-Juniper Woodland

b = 1979-80 Pinyon-Juniper Woodland/Sagebrush Shrubland

c = 1979-80 Tamarisk Wash

d = 1979-80 Sagebrush Mixed Shrub

e = 1981-82 Pinyon-Juniper Woodland

f = 1981-82 Greasewood Saltbush

g = 1981-82 Sagebrush Shrubland

h = 1982-83 Sagebrush Shrubland J-19

i = 1982-83 Sagebrush Shrubland J-21

j = 1982-83 Saltbush-Greasewood RV

k = 1982-83 Saltbush-Greasewood DW

l = 1982-83 Pinyon-Juniper Woodland J-20

m = 1982-83 Pinyon-Juniper Woodland J-21

Spot Map Bird Census Grids (Pinyon-Juniper Woodland)

x = 1983-84 J-10

y = 1983-84 J-20

z = 1983-84 J-21

Prairie Dog Colonies

This census technique was used to compare the relative efficiency and accuracy of the Emlen-type sampling method (Arizona Division, PCC 1985).

Migrant waterfowl and shorebird counts were conducted during the spring and fall from 1982 through 1984 at several large impoundments. Stops were made at frequent intervals during migration to record the numbers and sex (where possible) of each species observed.

Specific reconnaissance for raptors and raptor nest sites were conducted seasonally by EH&A biologists in 1979 and 1980. Reconnaissance was conducted both on and adjacent to the leasehold. Spring nesting surveys for Red-tailed Hawks and seasonal reconnaissance for all raptor species have been conducted by Peabody biologists since 1982. All raptor sightings are recorded and notes are kept on foraging behavior, nesting habits and habitat preference.

Mammals. Mammals were surveyed on the leasehold by direct observation, capture, or detection of tracks, scats, dens or nests. Large and medium-sized mammals were quantitatively sampled using the Erickson Cruise Census (Giles 1971), spotlight surveys and predator scent stations (Turkowski 1979). An aerial census for mule deer was conducted by EH&A in 1980. Data is also available from an aerial census conducted by the Navajo Tribe.

Erickson cruise counts were conducted along the same transects used to conduct the bird studies. The observation or flushing distance from the transect was recorded for the purpose of deriving population size estimates.

Spotlight counts were conducted in the spring and fall along the bird road cruise census routes. Two 150,000 candle, hand-held spotlights were used on each side of a vehicle driven slowly along the route. Results were expressed as numbers of a given species observed per unit distance traveled.

Predator scent stations were maintained in each habitat type represented in a particular sample area, on alternating sides of the route used for the bird road cruise census. Stations were placed at 0.5 kilometer intervals on alternating sides of the road. A station consisted of a small perforated capsule located in the center of a 0.914 square meter circle of sifted soil or undisturbed snow. Small sponges, impregnated with a suitable trapping lure were placed in the capsules. Stations were checked for three

consecutive days each season. Tracks of one or more individuals of a given species constituted a station visit. Results were expressed as the ratio of visits to station nights.

Small mammals were sampled using Sherman live traps and Museum Special snap traps. Traps were set at 30-meter intervals along the 1,500 meter Emlen transects. In 1979 and 1980, EH&A biologists used 50 traps per line and every fourth trap was a Museum Special. Traplines were run for four consecutive nights in the spring and fall in each habitat type. Oatmeal was used for bait. In subsequent years, trap lines were run for three consecutive nights and the snap traps were eliminated. Results were expressed as trap-night ratios. In addition to the regularly scheduled trapping periods, incidental small mammal trapping was conducted in minor habitats where specific physical characteristics of the soil and landform indicated that additional taxa might be documented.

Gunnison's prairie dog surveys were conducted in the western and northeastern portions of the leasehold in September, 1980 (EH&A 1980). The point-centered quarter technique was used to determine active burrow density. Prairie dog surveys in the southeastern portion of the leasehold were conducted by physically marking and counting all active burrows in the colony. Colony locations are shown on Figure 2.

Black-footed ferret surveys were conducted in conjunction with the prairie dog surveys. The 1980 survey followed methods recommended by the Albuquerque Endangered Species Office of the USFW and was conducted by EH&A biologists. Burrows were systematically searched for ferret sign including: trenches or stringers of soil with a groove in the center which radiates outward from burrows; burrows plugged with soil; skeletal material; mustelid scats; and prairie dog alarm responses. Approximately seven man-days were expended searching for ferret sign in the 1980 survey. Black-footed ferret surveys were continued in the southeastern portion of the lease by Peabody biologists in 1984, and other colonies in 1985. Burrows were periodically checked during periods of snow cover as recommended by Clark et al. (1983). Approximately thirty man-hours of effort have been expended each winter to check the colonies.

No specific surveys of bats (Order Chiroptera) have been conducted on the Black Mesa leasehold. Consequently, no species have been identified. A list of those species of potential occurrence on the Black Mesa was developed from range maps by Cockrum (1960).

Aquatic Communities. Aquatic communities identified on the Black Mesa leasehold consist of man-made impoundments. Aquatic surveys were conducted in July 1980 by EH&A biologists at the J-7 impoundment and at a small water catchment in the pre-law J-3 reclaimed mining area. Because of its size and permanence, field efforts were concentrated at the J-7 impoundment (Drawing 85325). The aquatic survey included qualitative and quantitative sampling of macrophytes, phytoplankton, zooplankton, macroinvertebrates, fishes, and selected water quality parameters. For detailed descriptions of the methods used to conduct these aquatic surveys, reference may be made to EH&A (1980).

Wildlife Habitats

The land area in and surrounding the Black Mesa leasehold can be stratified into several major wildlife habitats. These generally coincide with the vegetation communities identified in the baseline vegetation resource studies (Chapter 9). However, much of the study area is transitional in nature. The integration of the major habitats and the activity patterns of many of the wildlife species, results in a faunal assemblage in any given habitat that is composed of species typically associated with one or more other habitats. The ecotones are preferred by many species which are present.

The major habitats are discussed below under separate subheadings. The vegetation of each is characterized in detail in Chapter 9. The soils are discussed in Appendix A. The distribution of the wildlife habitats on and immediately surrounding the leasehold is shown on Drawing 85320, Sheets 1 through 5.

Pinyon-Juniper Woodland. The pinyon-juniper woodland (Figure 3) is the most extensive wildlife habitat occurring on the leasehold. It occupies approximately 65-70 percent of the land surface. This habitat dominates the landscape in the areas to be disturbed by mining, except the J-7 mining area. It may be placed in the broader Great Basin Conifer Woodland Biotic Community of Brown (1982).

Throughout its geographic distribution, the woodland is characterized by the unequal dominance of only a few species of the two genera Pinus and Juniperus. Colorado pinyon (P. edulis) and Utah juniper (J. oesteosperma) share dominance on the Black Mesa leasehold. The tree density and proportion of each species varies with elevation. Generally, tree density and the proportion of pinyon increase with increasing elevation. The vegetation understory is variable, ranging from areas completely devoid of vegetation

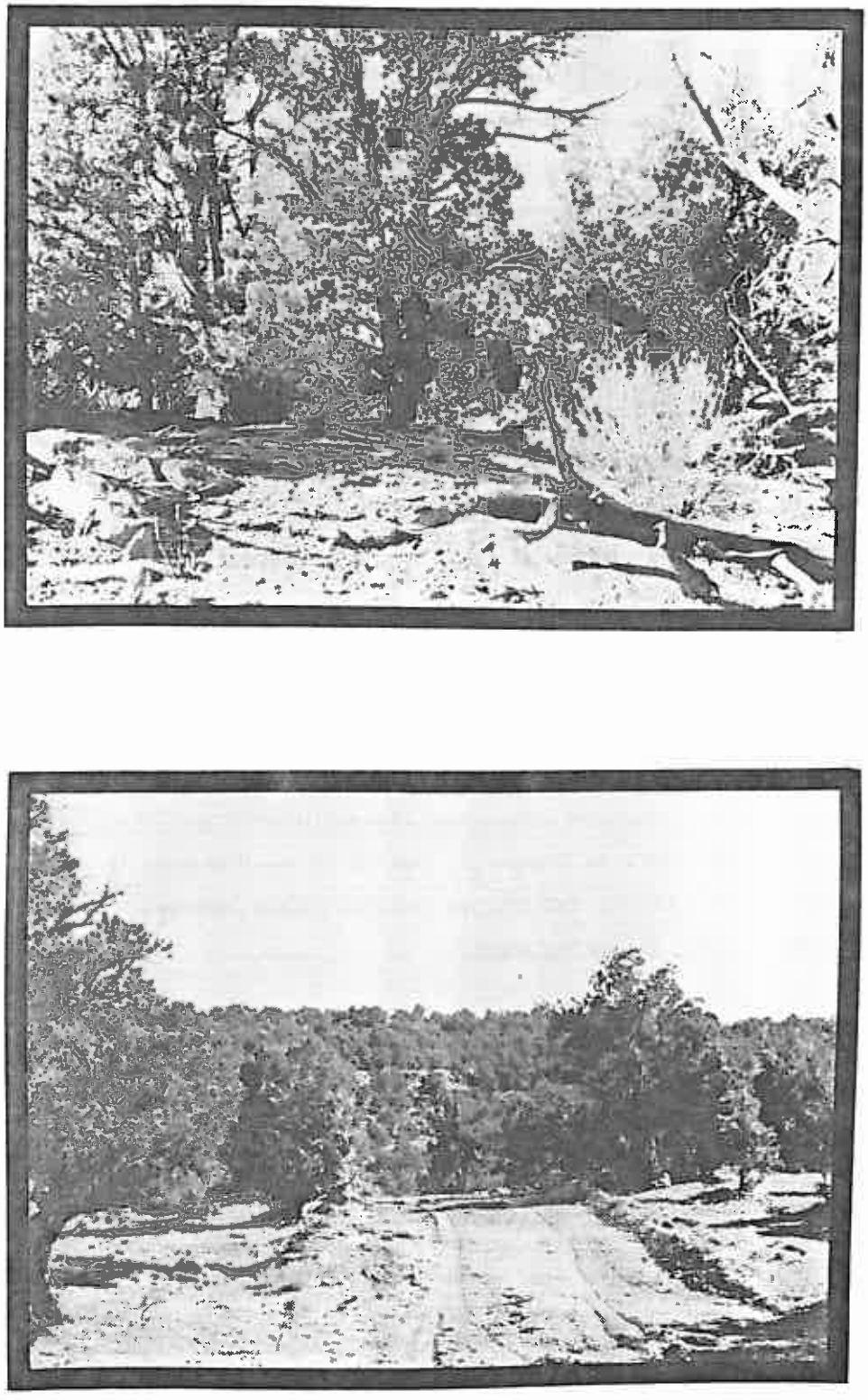


FIGURE 3

Pinyon-Juniper Woodland Habitat

cover to areas of sparse, scattered graminoids, forbs, and sub- and true shrubs. In localized areas where deeper soils exist, big sagebrush (Artemisia tridentata) and fourwing saltbush (Atriplex canescens) are subdominants. Cliffrose (Cowania mexicana) is the principle subdominant on shallower, rocky sites. At the higher elevations and most mesic sites, gambel oak (Quercus gambelii) occurs. The principle herbaceous plant is the sub-shrub, snakeweed (Gutierrizia sarothrae).

The woodland habitat occurs on steep, rocky slopes with coarse or extremely fine, shallow soils. In this setting, the soils are typically severely eroded. The woodland also occurs on relatively flat mesa tops, where the soils are somewhat deeper and less eroded. The principal habitat contact with the woodland is shrublands.

Shrublands. Shrublands are the second most extensive wildlife habitats on the leasehold. The shrublands may be placed as series within the Great Basin Desertscrub Biotic Community described by Turner (1982). Three shrubland series are recognized on the basis of the dominant shrub species composing the type. These are the sagebrush shrubland, which is dominated by big sagebrush, the saltbush shrubland, which is dominated by fourwing saltbush and the greasewood shrubland, which is dominated by black greasewood (Sarcobatus vermiculatus). One or more of the three series occur in all mining areas. The three shrublands are placed together for the purpose of discussion because of their physiognamic similarity. The principal habitat contact with the shrublands is pinyon-juniper woodland.

The sagebrush series is the most extensive of the three shrubland habitats. It occupies approximately 30-35 percent of the leasehold. As the name implies, big sagebrush dominates the vegetation to the virtual exclusion of other shrub species at the intermediate and higher elevations (Figure 4). The understory is dominated by grasses; primarily blue grama (Bouteloua gracilis). At lower elevations and on shallow sites, the dominance of big sagebrush is less pronounced. A mixed shrub system occurs (Figure 5) with big sagebrush occurring with one or more codominant shrubs or subshrubs. The codominates include Greene's rabbitbrush (Chrysothamnus greenei), shadscale (Atriplex confertifolia), fourwing saltbush and, to a lesser extent, snakeweed. The sagebrush habitat occupies the valley side slopes and dissected plains with deep alluvial soils.

The greasewood (Figure 6) and saltbush (Figure 7) shrublands are of much less extensive area than the sagebrush shrubland. Together they occupy less than three percent of the land surface on the leasehold. These shrublands form pure stands, or occasionally

FIGURE 4

Sagebrush Shrubland Habitat

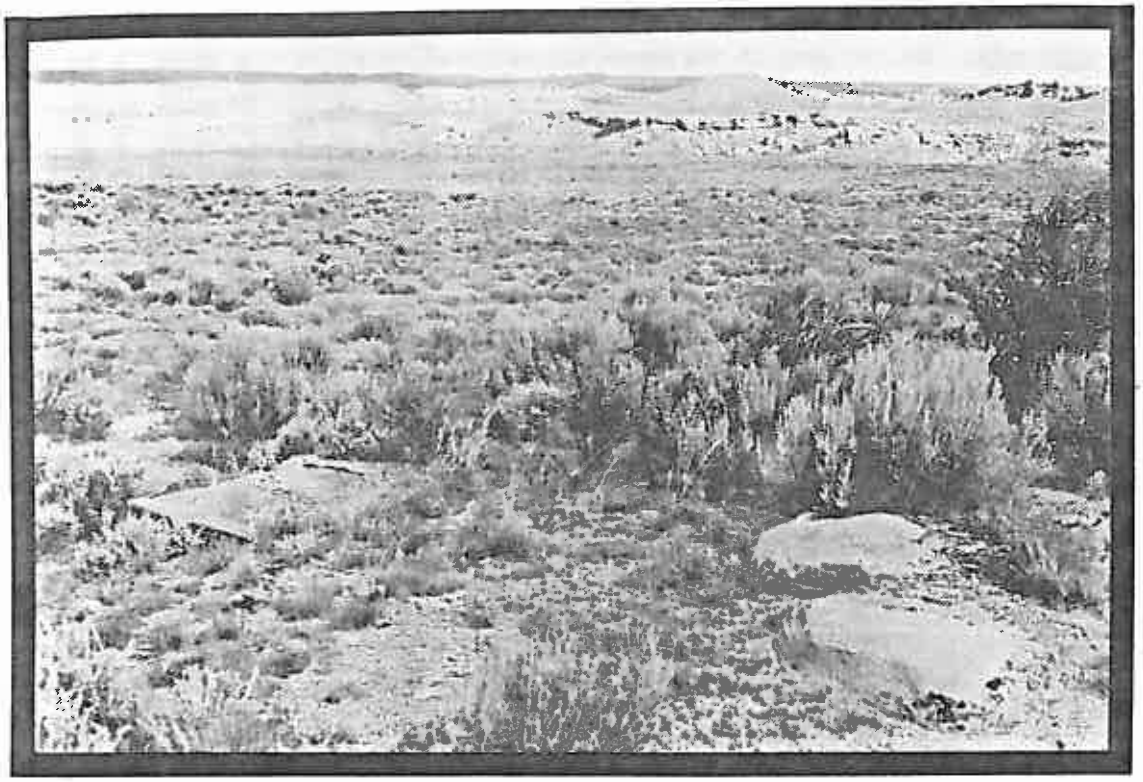


FIGURE 5

Sagebrush-Mixed Shrub Habitat

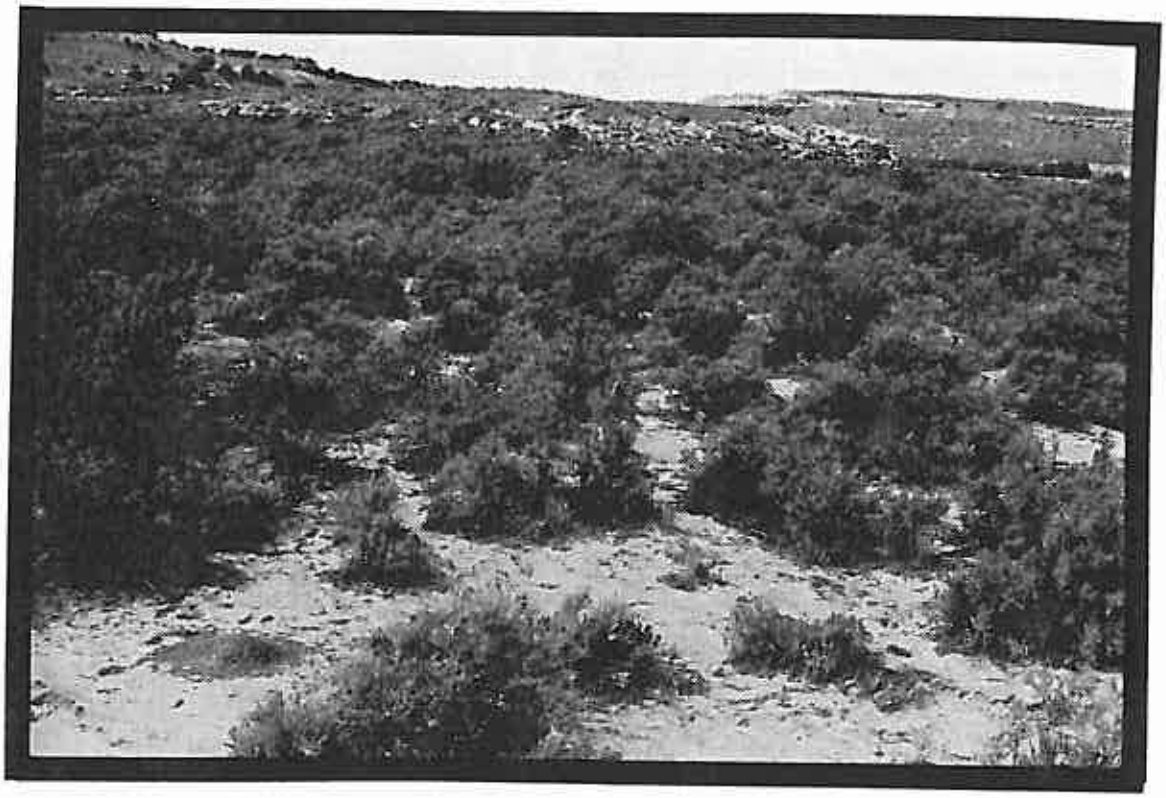


FIGURE 6

Greasewood Shrubland Habitat

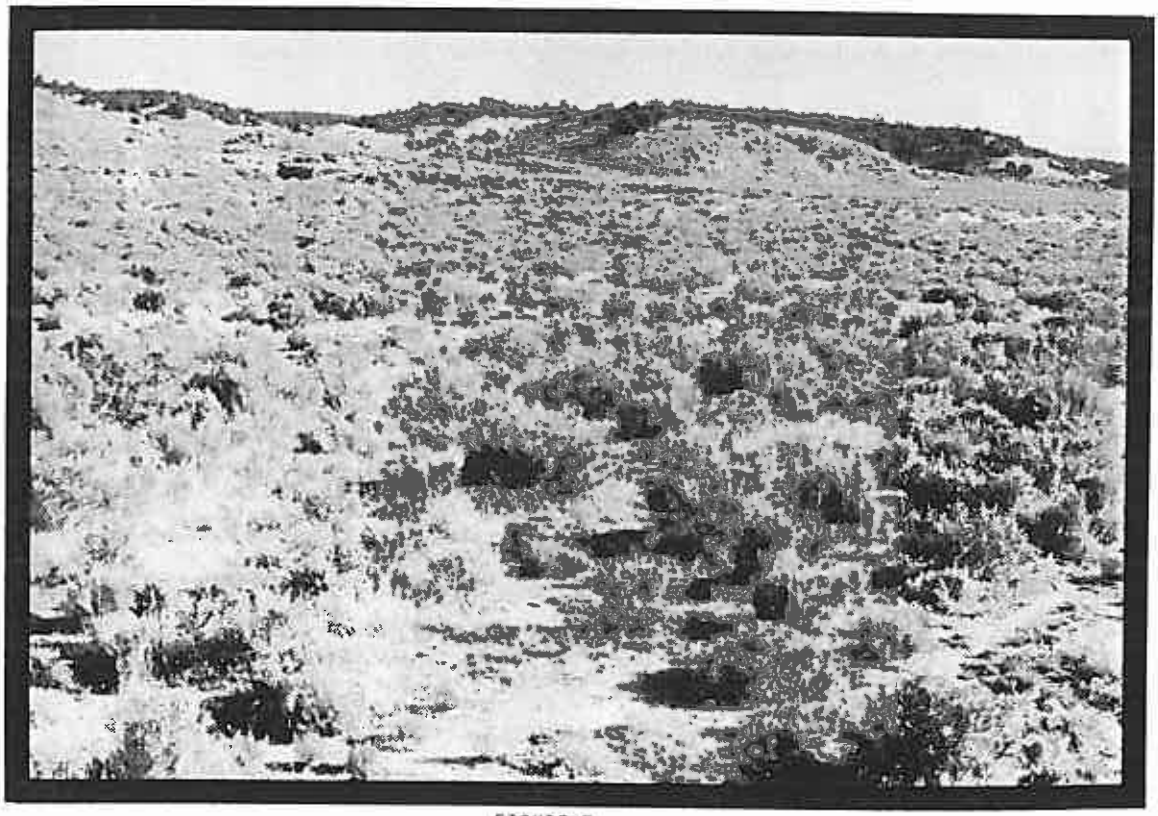


FIGURE 7

Saltbush Shrubland Habitat

intergrade. Edaphic conditions restrict the occurrence of these shrublands to the terraces of the larger washes and the extreme edges of smaller incised washes.

Mixed Conifer Woodland. The mixed conifer woodland occurs near the north and east rims of the Black Mesa at elevations ranging from approximately 6800 feet to 8100 feet. It is found primarily in the deep canyons leading away from the rim toward the southwest, and along sheltered cliff bases along the mesa rim. It dominates the headwaters of Yellow Water, Coal Mine, and Moenkopi washes and shallow drainages on the mesa summit. Small isolated stands exist further southwest (e.g., at the confluence of Reed Valley and Moenkopi Wash). On the Black Mesa leasehold, it is restricted to the extreme northeastern portion of the area northeast of the N-10 mine plan area (see Drawing No. 85320a). It does not occur in any mining areas or other areas that will be disturbed.

Mixed conifer woodland habitat occurs in specific areas on northern Black Mesa where local conditions favor its development. These conditions result in increased available moisture and include: 1) deep, sheltered, and shaded canyons; 2) north-facing slopes; 3) joint traces and cracks where runoff is concentrated from exposed Yalepoint sandstone; and 4) small shallow drainages above 7400 feet where runoff is also concentrated. The mesa tops and ridges between the canyons are dominated by pinyon-juniper woodland.

The mixed conifer woodland may be placed in the Rocky Mountain (Petran) and Madrean Montane Conifer Forests Biotic Community described by Pase and Brown (1982). Characteristic tree species include the diagnostic Douglas fir (Pseudotsuga menziesii), ponderosa pine (Pinus ponderosa), and a pinyon-juniper woodland component of Colorado pinyon, Utah juniper, and Rocky Mountain juniper (Juniperus scopulorum). An isolated stand of white fir (Abies concolor) is present at Lolomai Point at the northernmost rim. The understory is varied but usually includes Gambel oak, snowberry (Symphoricarpus sp.), cliff fendlerbush (Fendlera rupicola), mountain mahogany (Cercocarpus intricatus), and wax current (Ribes cereum). Common understory graminoids include muttongrass (Poa fendleriana), western wheatgrass (Agropyron smithii), pine dropseed (Blepharoneuron tricholepsis), and mountain muhly (Muhlenbergia montana).

The mixed conifer woodland exhibits several other abiotic characteristics which distinguish it from most other common habitats on northern Black Mesa. Most of the canyons where this habitat occurs contain cliffs exceeding 20 feet in height. The cliffs usually contain a preponderance of crevices, breaks, and potholes. The habitat is also

characterized by the presence of large boulders and rubble at the bases of the cliffs, and on the exposed portions of steep slopes. The protected nature of the canyons result in a old growth situation; pine trees and firs with basel diameters exceeding 20 inches are common in most stands and most stands are multistoried. Standing snags exceeding 35 feet in height are common, and the understory contains a great amount of downed timber and woody litter. Drainage bottoms often contain surface water from seeps and springs emitting from the shallow and exposed bedrock, or from runoff collected in protected potholes and scour holes. However, well developed riparian vegetation is absent.

No quantitative baseline wildlife studies were conducted in the mixed conifer woodland because of its limited extent in the permit area and because no mining or related disturbances are planned in its vicinity.

Riparian Strand and Aquatic Areas. Riparian and aquatic (open water and shoreline) wildlife habitats occur on the leasehold to a limited extent. They occupy less than two percent of the leasehold. Mining and related activities are typically not planned in areas occupied by these habitats. However, because they occur near disturbance areas, they were considered in quantitative wildlife studies.

The riparian strand habitat (Figure 9) occurs intermittently along major drainageways as linear "stringers" of disclimax vegetation dominated by tamarix (Tamarix pentandra). The stringers range from approximately 10 to 20 feet in width and extend from a few yards to over one-half mile in length. This habitat is restricted to the immediate bottoms of washes, and typically occupies agrading portions of the channels. The vegetation can be completely eradicated at a given location depending upon flow conditions in the washes. The tamarix riparian strand habitat is a series within the Great Basin Riparian Strand Biotic Community described by Minckley and Brown (1982). It typically occurs at elevations below 6,300 feet. Above that elevation, the washes are relatively barren within the streambed. The major contact with this habitat is shrublands occurring on the terraces above the wash channels.

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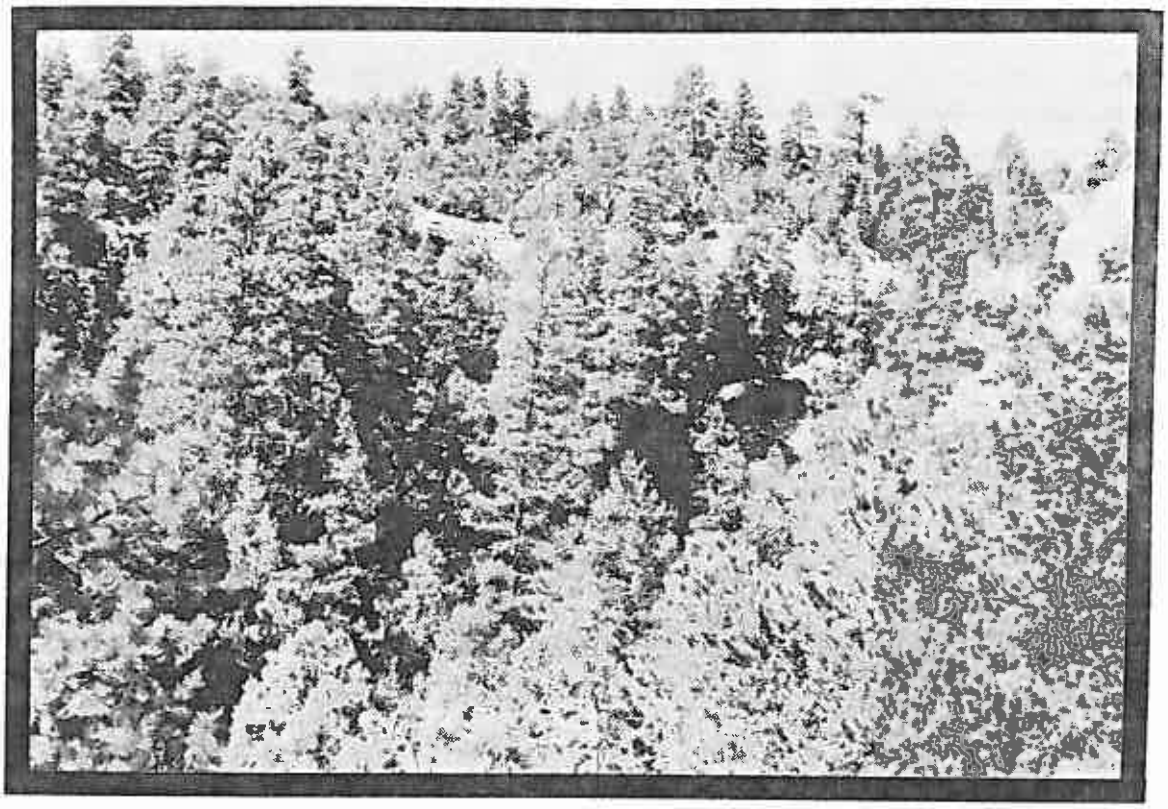

FIGURE 8

Mixed Conifer Woodland Habitat

FIGURE 9

Strand Habitat

The aquatic habitats include the freshwater ponds, sediment control structures and internally draining impoundments in reclaimed areas. Because of their size and potential for impounding permanent water, the MSHA impoundments are the most important structures for providing aquatic habitat. No naturally occurring ponds or open water situations occur on the leasehold.

The oldest of the large impoundments is the J-7 pond (Figure 10). This pond has stabilized and supports a relatively diverse fauna and flora. In 1980, this pond was measured about 76 meters at its maximum width and about 460 meters at its maximum length. The maximum depth was 4.7 meters.

Results and Discussion of the Fish and Wildlife Resource Studies

The fish and wildlife resources of the Black Mesa leasehold and vicinity are discussed below by subsections which address the major taxonomic groups. The results from surveys conducted in different years, by different observers and in different sections of the leasehold, are consolidated when appropriate to do so. Certain data, such as the bird density data, cannot be consolidated and still maintain habitat resolution and account for the effects of migration and timing of samples on density and diversity.

Birds. The bird species recorded on or near the Black Mesa leasehold and their seasonal status, habitat preference and relative abundance by season are listed in Table 1. The table was constructed from information derived from on-site lists prepared by EH&A, road cruise data, variable width transect data and records kept by Peabody biologists. There are 203 species from 41 families of 16 orders represented. The families represented by the most species in Table 1 include the Emberizidae (39), Anatidae (22) and Scolopacidae (15).

The total number of birds that are known or are suspected to breed in the habitats identified on or near the leasehold comprise 53.7 percent of the total number of species that have been recorded (Table 2). The mixed conifer woodland supports the greatest number of breeding bird species, followed by the pinyon-juniper woodland. A lesser percentage of the total number of species that are known or suspected to breed in each habitat are considered restricted to the type.

Slightly more than 50 percent of the species observed on or near the leasehold are

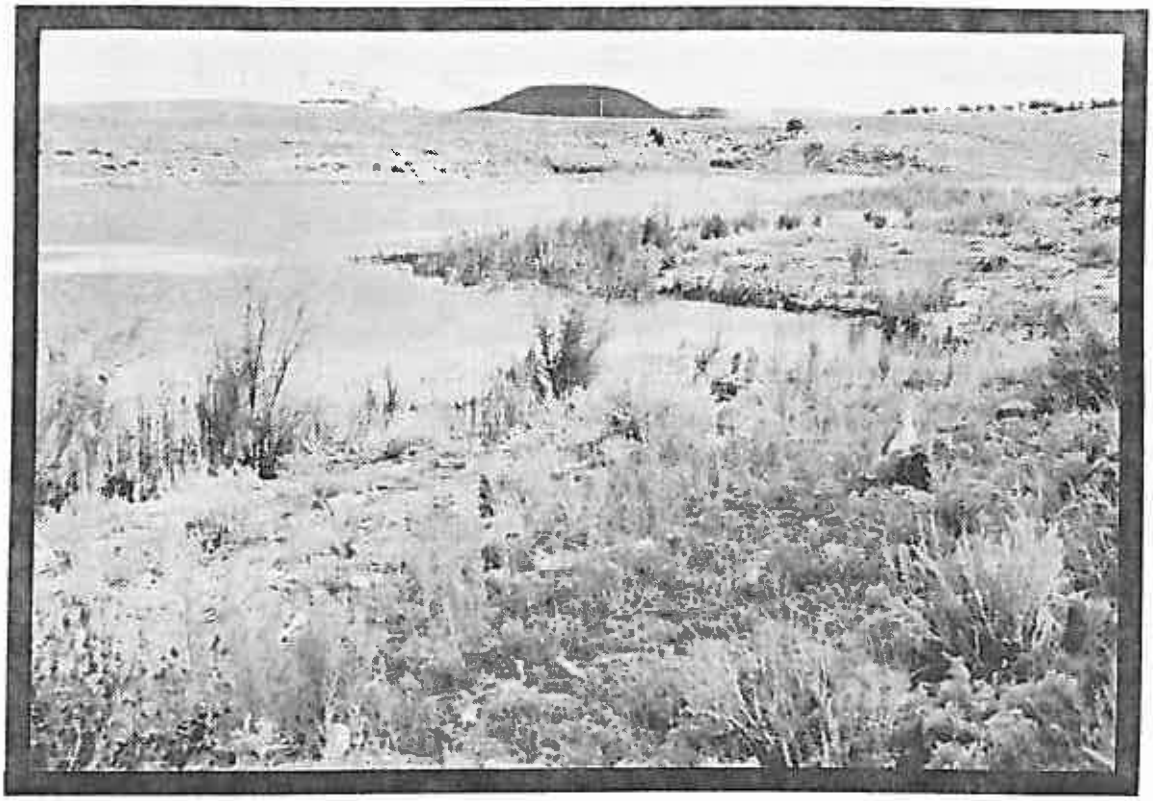

FIGURE 10

Aquatic Habitat (J-7 Pond)

TABLE 1

Bird Species Recorded Within or Near the Black Mesa Leasehold[1]

Common Name[2]	Seasonal Status[3]	Habitat Preference[4]	Relative Seasonal Abundance[5] Spring	Summer	Fall	Winter
Common Loon	M	AA	R	R	-	-
Pied-billed Grebe	M	AA	U	U	U	-
Horned Grebe	M	AA	R	-	-	-
Eared Grebe	M	AA	C	-	C	-
Western Grebe	M	AA	U	-	U	-
American White Pelican	M	AA	R	-	R	-
Great Blue Heron	M	AA	C	U	C	R
Snowy Egret	M	AA	U	U	U	-
Cattle Egret	M	AA	R	-	R	-
Black-crowned Night-Heron	M	AA	R	-	R	-
White-Faced Ibis	M	AA	U	U	U	-
Snow Goose	M	AA	-	-	R	-
Canada Goose	M	AA,RA	R	-	R	R
Green-winged Teal	M	AA	C	U	C	U
Mallard	M	AA	U	U	U	U
Northern Pintail	M	AA	U	R	U	-
Blue-winged Teal	M	AA	R	-	-	-
Cinnamon Teal	M	AA	C	C	C	-
Northern Shoveler	M	AA	C	R	C	R
Gadwall	M	AA	C	-	C	R
Eurasian Wigeon	M	AA	A	-	-	-
American Wigeon	M	AA	C	-	C	-
Canvasback	M	AA	R	-	R	-
Redhead	M	AA	C	R	C	-
Ring-necked Duck	M	AA	C	-	C	-
Greater Scaup	M	AA	R	-	-	-
Lesser Scaup	M	AA	C	-	C	-
Common Goldeneye	M	AA	R	-	-	-
Bufflehead	M	AA	R	-	-	R

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance			
			Spring	Summer	Fall	Winter
Hooded Merganser	M	AA	R	-	-	-
Common Merganser	M	AA	U	-	-	-
Red-breasted Merganser	M	AA	R	-	-	-
Ruddy Duck	M	AA	C	U	-	-
Turkey Vulture	S	All	C	C	C	-
Osprey	M	AA	R	R	R	-
Bald Eagle	M	MC,PJ	-	-	-	R
Northern Harrier	W	GL,SL	U	-	U	U
Sharp-shinned Hawk	P	PJ,MC	C	R	U	R
Cooper's Hawk	P	PJ,MC	U	U	U	U
Northern Goshawk	P	PJ	U	R	U	U
Swainson's Hawk	M	GL	R	-	-	-
Red-tailed Hawk	P	All	C	C	C	C
Ferruginous Hawk	M	GL	R	-	R	-
Rough-legged Hawk	W	RA	-	-	-	R
Golden Eagle	M	All	-	-	R	R
American Kestrel	P	All	C	C	C	R
Merlin	W	GL,SL	-	-	R	R
Peregrine Falcon	M	All	-	R	-	-
Prairie Falcon	P	GL	U	U	U	U
Chukar	P	GL,SL	R	R	R	R
Sora	M	AA	R	-	R	-
American Coot	S	AA	C	C	C	U
Semipalmated Plover	M	AA	R	-	-	-
Killdeer	P	AA	C	C	C	U
Black-necked Stilt	M	AA	R	R	-	-
American Avocet	M	AA	U	U	U	-
Greater Yellowlegs	M	AA	U	U	U	-
Lesser Yellowlegs	M	AA	C	U	C	-
Solitary Sandpiper	M	AA	R	U	R	-
Willet	M	AA	U	-	-	-

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance Spring	Summer	Fall	Winter
Spotted Sandpiper	S	AA	C	C	C	-
Long-billed Curlew	M	AA	R	R	-	-
Marbled Godwit	M	AA	U	-	-	-
Western Sandpiper	M	AA	U	-	U	-
Least Sandpiper	M	AA	C	-	C	-
Baird's Sandpiper	M	AA	-	-	R	-
Pectoral Sandpiper	M	AA	-	-	R	-
Long-billed Dowitcher	M	AA	U	-	U	-
Common Snipe	M	AA	U	-	U	R
Wilson's Phalarope	M	AA	U	U	U	-
Northern Phalarope	M	AA	R	-	-	-
Franklin's Gull	M	AA	R	-	-	-
Bonaparte's Gull	M	AA	U	-	U	-
Ring-billed Gull	M	AA	C	U	-	U
California Gull	M	AA	R	-	-	-
Herring Gull	M	AA	R	-	-	-
Common Tern	M	AA	R	-	-	-
Forster's Tern	M	AA	U	-	R	-
Black Tern	M	AA	-	R	-	-
Mourning Dove	S	All	C	C	C	-
Greater Roadrunner	P	SL	R	R	R	R
Flammulated Owl	M	PJ	-	-	R	-
Western Screech-Owl	P	PJ	R	R	R	R
Great-horned Owl	P	All	U	U	U	U
Northern Pygmy Owl	P	MC	U	U	U	U
Spotted Owl	S	MC	U	U	R	-
Long-eared Owl	W	PJ	R	-	-	-
Common Nighthawk	S	PJ	-	C	-	-
Common Poorwill	S	PJ	R	-	-	-
White-throated Swift	S	All	C	C	C	-
Black-chinned Hummingbird	S	PJ	U	U	U	-
Broad-tailed Hummingbird	S	MC	U	C	-	-

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance			
			Spring	Summer	Fall	Winter
Rufous Hummingbird	M	PJ	-	C	-	-
Belted Kingfisher	M	AA	R	-	R	-
Lewis' Woodpecker	M	MC	-	R	-	-
Red-naped Sapsucker	M	MC	U	-	U	-
Williamson's Sapsucker	M	MC	R	-	-	-
Downy Woodpecker	M	MC	R	-	-	-
Hairy Woodpecker	P	PJ,MC	C	C	C	C
Northern Flicker	P	PJ,MC	C	C	C	C
Olive-sided Flycatcher	M	PJ	U	-	U	-
Western Wood-Pewee	M	MJ	-	U	U	-
Dusky Flycatcher	S	MC	-	C	-	-
Gray Flycatcher	S	PJ	C	C	C	-
Western Flycatcher	S	MC	C	C	U	-
Say's Phoebe	S	CT,HS,SL	C	C	C	-
Ash-throated Flycatcher	S	PJ	C	C	-	-
Cassin's Kingbird	S	PJ	U	U	U	-
Western Kingbird	S	HS,PJ	R	R	-	-
Purple Martin	M	SL	-	-	R	-
Horned Lark	P	GL,RA,SL	C	C	C	C
Tree Swallow	M	AA	C	-	C	-
Violet-green Swallow	S	AA,CT	C	C	C	-
Northern Rough-winged Swallow	S	AA,CT	U	U	U	-
Bank Swallow	M	AA	R	-	R	-
Cliff Swallow	M	AA	U	U	R	-
Barn Swallow	M	AA	U	-	U	-
Steller's Jay	P	MC	U	U	U	U
Scrub Jay	P	PJ,MC	C	C	C	C
Pinyon Jay	P	PJ	C	C	C	C
Clark's Nutcracker	P	MC	U	U	U	U
Common Raven	P	All	C	C	C	C
Mountain Chickadee	P	PJ,MC	C	C	C	C
Plain Titmouse	P	PJ	C	C	C	C

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance Spring	Summer	Fall	Winter
Bushtit	P	PJ,SL	C	C	C	C
Red-breasted Nuthatch	W	MC	-	-	U	U
White-breasted Nuthatch	P	PJ,MC	C	C	C	C
Pygmy Nuthatch	P	MC	C	C	C	C
Brown Creeper	P	MC,PJ	U	U	U	U
Rock Wren	S	CT	C	C	U	-
Canyon Wren	P	CT	C	C	C	U
Bewick's Wren	P	PJ	C	C	C	C
House Wren	S	MC	U	-	U	-
Marsh Wren	M	AA	-	-	R	-
Golden-crowned Kinglet	W	MC	-	-	-	R
Ruby-crowned Kinglet	M	PJ,MC	U	U	U	-
Blue-gray Gnatcatcher	S	PJ	C	C	C	-
Western Bluebird	P	PJ	C	C	C	U
Mountain Bluebird	P	PJ	C	C	C	U
Townsend's Solitaire	P	PJ	C	U	C	C
Hermit Thrush	S	MC	C	C	C	-
American Robin	P	PJ,MC	C	-	C	C
Northern Mockingbird	S	SL	U	U	-	-
Sage Thrasher	S	SL	C	C	U	-
Bendire's Thrasher	S	SL	R	R	-	-
Water Pipit	W	AA	C	-	C	R
Bohemian Waxwing	W	PJ	R	-	-	-
Cedar Waxwing	M	PJ	-	-	R	-
Northern Shrike	W	GL,SL	-	-	-	R
Loggerhead Shrike	P	GL,SL	U	U	U	U
European Starling	P	HS	C	C	C	C
Gray Vireo	S	PJ	R	R	R	-
Solitary Vireo	S	PJ	C	C	C	-
Warbling Vireo	S	MC	R	-	U	-
Orange-crown Warbler	M	AA	C	-	C	-
Nashville Warbler	M	AA	C	-	C	-

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance Spring	Summer	Fall	Winter
Virginia's Warbler	S	AA	C	C	C	-
Yellow Warbler	M	AA	U	R	U	-
Yellow-rumped Warbler	M	All	C	-	C	-
Black-throated Gray Warbler	S	PJ	C	C	C	-
Townsend's Warbler	M	MC,AA	-	-	C	-
Grace's Warbler	S	MC	U	U	-	-
Northern Waterthrush	M	AA	R	-	-	-
Kentucky Warbler	M	AA	-	-	R	-
MacGillivray's Warbler	M	AA,PJ	C	R	C	-
Common Yellow Throat	M	AA	-	-	C	-
Wilson's Warbler	M	AA	C	C	C	-
Western Tanager	S	PJ,MC	U	C	U	-
Black-headed Grosbeak	M	PJ,MC	R	R	-	-
Blue Grosbeak	S	AA	C	C	C	-
Lazuli Bunting	M	AA	-	R	-	-
Green-tailed Towhee	P	SL	C	C	C	-
Rufous-sided Towhee	P	SL	C	C	C	R
Chipping Sparrow	S	PJ,SL	C	C	C	-
Brewer's Sparrow	S	SL	C	C	C	-
Vesper Sparrow	S	GL	C	C	C	-
Lark Sparrow	S	SL	C	C	U	-
Black-throated Sparrow	S	SL	C	C	R	-
Sage Sparrow	P	SL	C	C	C	R
Lark Bunting	M	RA	R	-	-	-
Savannah Sparrow	M	AA	R	U	U	-
Song Sparrow	M	AA	U	-	-	U
Lincoln's Sparrow	M	AA	R	-	U	-
White-crowned Sparrow	M	SL	C	-	C	R
Dark-eyed Junco	W	All	C	R	C	C
Chestnut-collared Longspur	M	GL	-	-	R	-
Red-winged Blackbird	M	AA	C	U	C	-
Western Meadowlark	P	GL	C	C	C	U

TABLE 1 (Cont.)

Common Name	Seasonal Status	Habitat Preference	Relative Seasonal Abundance Spring	Summer	Fall	Winter
Yellow-headed Blackbird	M	AA	U	U	-	-
Brewer's Blackbird	S	AA	C	U	C	-
Great-tailed Grackle	M	GL	R	-	-	-
Brown-headed Cowbird	S	All	C	C	C	-
Northern Oriole	M	PJ	R	R	U	-
Scott's Oriole	S	PJ	U	U	-	-
Rosy Finch	W	SL	-	-	-	R
Cassin's Finch	W	PJ,MC	U	-	-	U
House Finch	P	PJ,HS	C	C	C	C
Red Crossbill	P	MC	U	U	U	U
Pine Siskin	P	PJ,MC	U	-	-	R
Lesser Goldfinch	S	PJ	U	U	U	-
American Goldfinch	W	PJ	U	-	-	U
Evening Grosbeak	W	PJ	-	-	R	-
House Sparrow	P	HS	C	C	C	C

TABLE 1 LEGEND

1 Observed by Peabody or consulting biologists on the leasehold or within a one mile boundary.

2 Common names follow the sequence and spelling of the 1983 American Ornithologists Union checklist.

3
M = Migrant
S = Summer Resident
W = Winter Resident
P = Permanent Resident

4
AA = Aquatic associated
PJ = Pinyon-juniper woodlands
GL = Grasslands
SL = Shrublands
MC = Mixed conifer woodlands
RA = Reclaimed areas
HS = Human settlements
CT = Cliff, talus, wash banks

5
C = Common: Always to be found in numbers
U = Uncommon: Expected to be found, but not in numbers
R = Rare: Found in very small numbers

TABLE 2

Total Number of Breeding Bird Species by Habitat Type

On or Near the Black Mesa Leasehold

Habitat Type	No. Known or Suspected to Breed	(% of Total)	No. Restricted To Type
Mixed Conifer Woodland	45	(42.1)	23
Pinyon-Juniper Woodland	34	(31.7)	10
Shrublands	11	(10.3)	6
Aquatic Associated	9	(8.4)	6
Reclaimed Areas	6	(5.6)	1
Human Settlements	2	(1.9)	2
Total	107	-	48

TABLE 3

Primary Seasonal Status of Bird Species Recorded

On or Near the Black Mesa Leasehold

Status	No. of Species	% of Total
Permanent Residents	41	20.2
Summer Residents	43	21.2
Winter Residents	15	7.4
Migrant	104	51.2
TOTAL	203	

migrants (Table 3). The number of species which join the permanent residents during the summer is greater than the number of permanent residents. Few additional species join the permanent residents in winter. The total number of known or suspected breeding species (Table 2) is greater than the combined total of permanent and summer residents, indicating that many species utilize more than one habitat for breeding purposes.

The results of three seasonal road cruise censuses which have been conducted on the leasehold are summarized in Table 4. The table presents the frequency of bird species detections over the combined routes. The results parallel the observations previously made; namely, bird diversity and numbers fluctuate seasonally because of migration effects.

The results of variable width transect studies in the pinyon-juniper woodland habitat and pinyon-juniper/sagebrush transition are presented in Tables 5 through 9. The locations of the transects are shown in Figure 2. The timing of the samples and the observers are noted in the tables. The tables indicate that the Bewicks wren, plain titmouse and mountain chickadee are among the most common species observed in the woodland and woodland transition. Summer wren densities ranged from 3.6 to 34.9 individuals per 40 ha ($\bar{x}$ = 18.6; s = 12.4; n = 6). Summer titmouse densities ranged from 1.8 to 29.9 individuals per 40 ha ($\bar{x}$ = 19.5; s = 9.6; n = 6).

In the spring, low to moderate bird species densities and diversity were found relative to other seasons (Tables 5 through 9). During the summer, the densities of those species observed in spring increased and additional species were encountered. The increased summer densities can be attributed, in part, to fledged offspring. Dramatic decreases in bird diversity and species densities were noted in the fall and winter. Other species common in and near the woodland habitat included the black-throated gray warbler, gray flycatcher, ash-throated flycatcher, pinyon jay and white-breasted nuthatch. The chipping sparrow was most commonly associated with the woodland transition to sagebrush shrubland.

The results of variable width transect studies in the sagebrush shrubland habitat and sagebrush-mixed shrub habitat are presented in Tables 10 and 11. The timing of the samples and the observers are noted in the tables. The locations of the transects are shown in Figure 2. The results are characterized by moderate to high densities of relatively few species. Sage sparrows and Brewer's sparrows were the most common birds found in pure sagebrush shrubland habitat during the height of activity in the spring and

TABLE 4

Seasonal Road Cruise Census Results

On the Black Mesa Leasehold[1]

Species	Frequency of Detections (%)[2]			
	Spring	Summer	Fall	Winter
Pied-billed Grebe	-	-	1.18	-
Mallard	-	-	0.59	-
Teal sp.	-	-	1.18	-
American Wigeon	-	-	1.18	-
Ruddy Duck	-	-	-	-
Turkey Vulture	-	0.59	-	-
Sharp-shinned Hawk	0.59	-	-	-
Goshawk	-	-	-	0.59
Red-tailed Hawk	1.18	1.18	1.76	1.76
American Kestrel	2.94	1.76	1.18	-
American Coot	-	-	1.18	-
Killdeer	-	1.18	-	-
Mourning Dove	2.35	16.47	-	-
Flammulated Owl	-	-	0.59	-
Common Nighthawk	-	10.59	-	-
White-throated Swift	-	1.76	-	-
Black-chinned Hummingbird	-	1.76	-	-
Broad-tailed Hummingbird	0.59	0.59	-	-
Hummingbird sp.	0.59	0.59	-	-
Red-naped Sapsucker	-	1.18	-	-
Hairy Woodpecker	2.35	0.59	1.76	0.59
Northern Flicker	4.71	0.59	4.71	-
Woodpecker sp.	-	-	0.59	-
Gray Flycatcher	15.88	13.53	-	-
Say's Phoebe	4.71	2.94	-	-
Ash-throated Flycatcher	7.65	30.00	0.59	-
Cassin's Kingbird	2.35	7.06	-	-
Horned Lark	11.76	4.71	11.76	11.18

TABLE 4 (Cont.)

Species	Frequency of Detections (%)[2]			
	Spring	Summer	Fall	Winter
Violet-green Swallow	1.18	1.76	-	-
Northern Rough-Winged Swallow	-	1.76	-	-
Swallow sp.	-	0.59	-	-
Scrub Jay	3.52	1.76	2.35	1.76
Pinyon Jay	40.00	15.88	21.76	8.24
Clark's Nutcracker	-	0.59	-	-
Common Raven	11.76	14.12	21.76	14.71
Mountain Chickadee	7.06	7.06	2.94	5.29
Plain Titmouse	35.88	35.88	4.71	12.35
Bushtit	7.65	1.76	-	1.18
White-breasted Nuthatch	8.24	10.59	3.52	1.76
Rock Wren	12.94	20.00	1.18	-
Bewick's Wren	41.18	41.76	1.76	3.52
Ruby-crowned Kinglet	4.12	-	2.35	-
Blue-gray Gnatcatcher	1.18	3.52	-	-
Western Bluebird	1.76	5.88	6.47	3.52
Mountain Bluebird	14.71	29.41	10.59	0.59
Bluebird sp.	-	3.52	-	-
Townsend's Solitaire	0.59	-	0.59	-
American Robin	0.59	-	-	-
Northern Mockingbird	-	2.35	-	-
Sage Thrasher	3.52	2.94	-	-
Bendire's Thrasher	0.59	-	-	-
Water Pipit	-	-	1.18	-
Loggerhead Shrike	0.59	1.18	0.59	-
European Starling	1.18	1.76	1.18	0.59
Gray Vireo	-	1.76	-	-
Solitary Vireo	2.35	-	-	-
Yellow-rumped Warbler	0.59	-	2.94	-
Black-throated Gray Warbler	15.88	1.76	-	-
Wilson's Warbler	0.59	-	-	-
Warbler sp.	0.59	-	-	-

TABLE 4 (Cont.)

Species	Spring	Summer	Fall	Winter
Blue Grosbeak	-	0.59	-	-
Green-tailed Towhee	-	1.18	-	-
Rufous-sided Towhee	8.82	0.59	-	-
Chipping Sparrow	29.41	18.82	-	-
Brewer's Sparrow	9.41	7.65	1.18	-
Vesper Sparrow	2.94	0.59	-	-
Lark Sparrow	1.76	0.59	-	-
Black-throated Sparrow	1.76	2.35	-	-
Sage Sparrow	4.12	7.65	1.76	-
Song Sparrow	-	1.18	-	-
White-crowned Sparrow	1.18	-	2.35	0.59
Dark-eyed Junco	1.18	-	11.18	2.94
"Grey-headed" Junco	1.18	-	-	1.18
Chestnut-collared Longspur	-	-	0.59	-
Sparrow sp.	3.52	4.12	0.59	-
Western Meadowlark	-	-	1.18	-
Meadowlark sp.	8.82	-	1.18	-
Yellow-headed Blackbird	1.18	-	-	-
Brewer's Blackbird	1.76	2.35	-	-
Brown-headed Cowbird	2.35	7.06	-	-
Cassin's Finch	0.59	-	-	1.76
House Finch	22.35	15.29	12.35	2.94
Pine Siskin	-	0.59	0.59	0.59
House Sparrow	0.59	2.35	-	-
Unknown Bird	9.41	3.52	3.52	-

[1]Results are consolidated from census routes established in three areas of the leasehold and conducted in: (1) 1979-80 by EH&A biologists (32.18 km route replicated twice); (2) 1981-82 by Peabody biologists (16.1 km route replicated twice); and (3) 1982-83 by Peabody biologists (18.0 km route replicated twice).

[2]Percent of total of 3-minute station stops at which a species was detected.

TABLE 5

Bird Densities in Pinyon-Juniper Woodland Habitat
At the N-14 Mining Area[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
Common Nighthawk	-	0.36	-	-
Broad-tailed Hummingbird	-	8.90	-	-
Gray Flycatcher	8.90	1.80	-	-
Say's Phoebe	0.36	-	-	-
Ash-throated Flycatcher	0.60	3.50	-	-
Steller's Jay	-	-	1.80	-
Scrub Jay	-	-	1.80	-
Pinyon Jay	-	0.36	-	-
Mountain Chickadee	1.80	2.70	1.80	6.20
Plain Titmouse	7.10	21.30	-	-
Bushtit	-	4.40	-	-
White-breasted Nuthatch	1.80	3.50	-	1.80
Canyon Wren	0.36	1.80	0.60	-
Bewick's Wren	3.50	7.10	-	-
Ruby-crowned Kinglet	-	-	1.80	-
Blue-gray Gnatcatcher	-	2.30	-	-
Western Bluebird	8.90	3.50	-	1.80
Solitary Vireo	1.80	2.70	-	-
Black-throated Gray Warbler	12.40	-	-	-
Rufous-sided Towhee	0.70	-	0.60	-
Dark-eyed Junco	-	-	3.50	-
Brown-headed Cowbird	-	8.90	-	-
Cassin's Finch	0.70	-	-	1.80
House Finch	-	5.30	-	-

[1] Study conducted by EH&A (1979-1980).

TABLE 6

Bird Densities in Sagebrush Shrubland/Pinyon-Juniper Woodland Transition At the N-14 Mining Area[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
American Kestrel	0.36	1.20	-	-
Common Nighthawk	-	1.10	-	-
Hairy Woodpecker	-	-	3.50	-
Northern Flicker	-	3.50	1.80	-
Gray Flycatcher	1.80	-	-	-
Horned Lark	-	7.10	-	-
Scrub Jay	-	-	3.50	-
Pinyon Jay	0.70	26.60	19.60	-
Mountain Chickadee	-	1.80	1.80	1.80
Plain Titmouse	8.20	1.80	7.10	-
Bewick's Wren	5.30	23.10	1.80	-
Ruby-crowned Kinglet	1.80	-	-	-
Mountain Bluebird	6.20	16.00	3.50	-
Solitary Vireo	0.36	-	-	-
Yellow-rumped Warbler	2.70	-	3.50	-
Black-throated Gray Warbler	0.90	3.50	-	-
Green-tailed Towhee	-	-	1.80	-
Chipping Sparrow	16.00	6.20	8.90	-
Brewer's Sparrow	0.36	5.30	-	-
Sage Sparrow	0.36	16.00	10.7	-
White-crowned Sparrow	3.50	-	-	-
Dark-eyed Junco	-	-	-	35.60
Sparrow sp.	1.80	0.36	-	-
Brown-headed Cowbird	1.80	1.80	-	-
House Finch	8.90	3.50	1.80	-

[1] Study conducted by EH&A (1979-1980).

TABLE 7

Bird Densities in Pinyon-Juniper Woodland Habitat
In the Vicinity of the J-16/28 Mining Areas[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
Belted Kingfisher	2.20	-	-	-
Hairy Woodpecker	1.80	3.60	1.80	-
Northern Flicker	2.70	2.10	1.80	-
Woodpecker sp.	2.20	-	-	-
Gray Flycatcher	7.10	2.70	4.40	-
Say's Phoebe	4.40	0.60	-	-
Ash-throated Flycatcher	-	11.60	-	-
Cassin's Kingbird	-	3.00	-	-
Steller's Jay	-	1.20	0.90	-
Scrub Jay	3.60	-	1.80	0.40
Clark's Nutcracker	-	0.90	-	-
Mountain Chickadee	1.80	11.60	16.90	3.6
Plain Titmouse	24.90	16.90	5.30	11.60
Bushtit	31.30	5.30	5.10	-
White-breasted Nuthatch	2.40	4.20	1.40	1.80
Bewick's Wren	5.30	14.20	-	-
Western Bluebird	-	1.80	-	-
Mountain Bluebird	6.70	5.30	-	-
Solitary Vireo	1.80	3.60	4.40	-
Warbling Vireo	-	3.00	-	-
Black-throated Gray Warbler	10.70	-	-	-
Warbler sp.	-	8.00	-	-
Rufous-sided Towhee	2.70	-	-	-
Chipping Sparrow	5.30	2.70	-	-
Brewer's Sparrow	3.60	-	-	-
Savannah Sparrow	-	-	30.20	-
Dark-eyed Junco	-	-	37.30	-
Sparrow sp.	10.70	14.20	-	-

TABLE 7 (Cont.)

Species	Spring	Summer	Fall	Winter
Meadowlark sp.	11.10	-	-	-
Brown-headed Cowbird	-	1.80	1.20	-
House Finch	0.40	3.60	-	-
Unidentified sp.	14.10	4.50	1.80	-

[1] Study conducted by Peabody (1981-1982).

TABLE 8

Bird Densities in Sagebrush Shrubland/Pinyon-Juniper Woodland Transition In the Vicinity of the J-16/28 Mining Areas[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
Hairy Woodpecker	-	2.70	-	-
Northern Flicker	-	0.60	0.40	-
Gray Flycatcher	16.00	2.20	1.80	-
Say's Phoebe	0.90	2.20	-	-
Ash-throated Flycatcher	-	5.30	-	-
Cassin's Kingbird	-	2.70	-	-
Scrub Jay	0.40	-	-	-
Mountain Chickadee	-	12.40	-	-
Plain Titmouse	16.00	23.10	-	-
Bushtit	7.10	1.80	-	124.40
White-breasted Nuthatch	2.70	5.30	-	-
Bewick's Wren	16.0	3.60	-	-
Mountain Bluebird	8.90	2.70	0.90	-
Hermit Thrush	-	0.90	-	-
Sage Thrasher	7.10	2.70	-	-
Solitary Vireo	-	12.40	-	-
Warbling Vireo	-	15.60	-	-
Black-throated Gray Warbler	17.80	4.40	-	-
Rufous-sided Towhee	-	0.90	-	-
Chipping Sparrow	42.70	8.00	-	-
Sage Sparrow	53.30	7.10	-	-
Dark-eyed Junco	-	-	46.20	-
Sparrow sp.	1.80	6.30	-	-
Meadowlark sp.	0.40	-	-	-
House Finch	-	11.80	-	-
Unidentified sp.	0.60	8.90	2.70	-

[1] Study conducted by Peabody (1981-1982).

TABLE 9

Bird Densities in Two Stands of Pinyon-Juniper Woodland
In the J-20 and J-21 Mining Areas[1]

Species	Bird Density (No./40 ha)							
	Spring		Summer		Fall		Winter	
	J-20	J-21	J-20	J-21	J-20	J-21	J-20	J-21
Hairy Woodpecker	-	-	-	4.4	-	-	-	-
Gray Flycatcher	5.3	4.7	10.6	19.0	-	-	-	-
Ash-throated Flycatcher	6.2	12.4	-	-	-	-	-	-
Scrub Jay	-	-	-	1.4	-	-	-	-
Mountain Chickadee	3.0	14.2	29.9	32.2	-	29.3	-	-
Plain Titmouse	21.8	30.2	24.0	29.9	30.2	15.4	11.1	-
Bushtit	-	9.8	-	-	-	-	-	-
White-breasted Nuthatch	8.0	10.0	11.7	14.8	-	-	4.4	-
Bewick's Wren	9.4	17.8	34.9	28.8	-	-	-	-
Ruby-crowned Kinglet	10.6	-	-	-	-	7.1	-	-
Blue-gray Gnatcatcher	-	-	-	3.0	-	-	-	-
Western Bluebird	-	-	-	-	-	-	-	5.3
Mountain Bluebird	-	4.0	-	4.1	-	-	-	-
Solitary Vireo	-	-	-	9.0	-	-	-	-
Yellow-rumped Warbler	-	-	-	-	-	16.3	-	-
Black-throated Gray Warbler	13.0	-	11.8	26.6	-	-	-	-
Chipping Sparrow	-	5.1	-	2.6	-	-	-	-
Dark-eyed Junco	-	-	-	-	-	-	-	12.3
House Finch	-	-	-	7.1	-	-	-	-

[1] Studies conducted by Peabody (1982-1983).

TABLE 10

Bird Densities in Sagebrush-Mixed Shrub (Rabbitbrush) Transition
In the Vicinity of the J-7 Mining Area[1]

Species	Bird Density (No. 40/ha)			
	Spring	Summer	Fall	Winter
Cooper's Hawk	-	-	-	1.40
Black-chinned Hummingbird	-	0.90	-	-
Hummingbird sp.	0.90	-	-	-
Say's Phoebe	-	0.90	-	-
Ash-throated Flycatcher	-	0.36	-	-
Horned Lark	17.80	10.10	109.30	186.70
Rock Wren	-	4.70	-	-
Western Bluebird	-	-	0.90	-
Bluebird sp.	-	-	0.36	-
Mockingbird	-	0.36	-	-
Sage Thrasher	0.90	-	0.90	-
Brewer's Sparrow	2.70	0.60	-	-
Vesper Sparrow	0.90	-	-	-
Black-throated Sparrow	-	1.80	-	-
Sage Sparrow	-	4.40	2.70	-
Sparrow sp.	0.60	-	-	-
Western Meadowlark	-	-	1.80	-
Brewer's Blackbird	-	-	0.90	-
House Finch	0.36	-	-	-

[1] Study conducted by EH&A (1979-1980).

TABLE 11

Bird Densities in Two Stands of Sagebrush Shrubland In the J-19 and J-21 Mining Areas[1]

Species	Bird Density (No./40 ha)							
	Spring		Summer		Fall		Winter	
	J-19	J-21	J-19	J-21	J-19	J-21	J-19	J-21
Bushtit	-	10.6	-	-	-	-	-	-
Bewick's Wren	6.1	4.7	11.5	32.5	-	-	-	-
Blue-gray Gnatcatcher	-	-	9.4	5.3	-	-	-	-
Western Bluebird	-	5.3	-	-	-	-	-	-
Mountain Bluebird	5.6	13.3	8.2	4.5	3.5	-	-	-
Yellow-rumped Warbler	-	-	-	-	4.6	4.2	-	-
Brewer's Sparrow	27.5	-	38.2	8.9	-	8.0	-	-
Sage Sparrow	41.2	37.5	29.3	33.3	12.4	-	-	-
House Finch	-	-	-	15.4	-	-	-	4.4

[1] Study conducted by Peabody (1982-1983).

summer. Horned larks were the most common birds found in the sagebrush-mixed shrub transition area because of its open character. The total number of species observed, and total and individual species density, dropped markedly in the fall and winter in the sagebrush shrubland. With the exception of horned lark populations, the same result occurred in the transition area as well.

The results of seasonal variable width transect studies in greasewood and saltbush habitat are presented in Tables 12 and 13. The studies were conducted on secondary or tertiary wash terraces. The transects overlapped greasewood, saltbush and sagebrush shrublands, and were in close proximity to woodland habitat. Consequently, the results reflect that many of the species encountered are not typically associated with this habitat. The rock wren, Say's phoebe, black-throated sparrow, Brewer's sparrow and house finch are typical of the habitat. This habitat is structurally similar to the sagebrush shrubland. Consequently, species diversity is relatively low when interfering species from adjacent habitats are not considered, but the species which typify the habitat occur in large numbers.

The results of seasonal variable width transects in a tamarix riparian strand habitat along Moenkopi Wash are characterized by moderate diversity and relatively high bird densities (Table 14). Rock wrens, white-crowned sparrows, dark-eyed juncos, and house finches are common occupants, depending upon the season. Several other species such as various warblers, the northern mockingbird, and killdeer prefer this habitat.

The results of spot-map sampling to determine breeding bird densities in pinyon-juniper woodland habitat are presented in Table 15. These studies resulted from the determination that variable width transects yielded variable results. The studies were presented and discussed in the Vegetation and Wildlife Resources 1984 Report (Arizona Division, PCC 1985) and are reviewed here only for comparative purposes. The studies indicated that the variable width transects generally give lower estimates of bird densities in woodland habitats. The results are more variable as well. Spot-mapping is generally agreed to be the more accurate method for measuring bird densities, but is very time consuming.

The results of raptor surveys by EH&A in 1979 and 1980 indicated that no raptor roosting or nesting sites occurred on the leasehold. Observation records compiled while conducting baseline studies after that time revealed that there is greater use of the habitats on the leasehold by several raptor species than the original studies indicated. Based upon the

TABLE 12

Bird Densities in Greasewood-Saltbush Habitat
In the Vicinity of the J-16 and J-28 Mining Areas[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
Rufous Hummingbird	-	2.20	-	-
Northern Flicker	-	1.80	2.70	0.90
Gray Flycatcher	-	8.00	-	-
Say's Phoebe	8.90	-	-	-
Ash-throated Flycatcher	6.70	-	-	-
Horned Lark	-	-	-	55.20
Scrub Jay	-	0.90	1.80	-
Mountain Chickadee	-	0.60	-	-
Bushtit	-	-	-	30.20
Rock Wren	11.10	0.90	2.70	-
Bewick's Wren	-	26.70	-	0.90
Mountain Bluebird	17.80	3.60	5.30	-
Solitary Vireo	-	4.40	-	-
Warbler	2.20	-	-	-
Chipping Sparrow	15.60	2.70	-	-
Brewer's Sparrow	-	7.10	-	-
Black-chinned Sparrow[2]	6.70	-	-	-
Vesper Sparrow	6.70	-	-	-
Lark Sparrow	15.60	-	-	-
Black-throated Sparrow	8.90	5.30	-	-
Sage Sparrow	22.20	20.00	-	-
White-crowned Sparrow	3.60	-	-	-
Dark-eyed Junco	8.90	-	39.10	248.90
Sparrow sp.	8.90	3.60	3.60	-
Meadowlark sp.	-	0.90	-	-
Cassin's Finch	1.80	-	-	-
House Finch	37.80	18.70	6.20	1.80
Pine Siskin	-	-	33.80	-
Unidentified sp.	-	18.80	-	-

[1]Studies conducted by Peabody (1981-1982). [2]Probable Misidentification

TABLE 13

Bird Densities in Two Stands of Greasewood-Saltbush Habitat In Reed Valley (RV) and Dinnebito Wash (DW)[1]

	Bird Density (No./40 ha)							
	Spring		Summer		Fall		Winter	
Species	RV	DW	RV	DW	RV	DW	RV	DW
Say's Phoebe	24.0	8.8	-	5.7	-	-	-	-
Horned Lark	-	8.8	-	50.3	-	49.8	-	41.4
Rock Wren	9.8	3.5	9.6	7.3	-	-	-	-
Bewick's Wren	5.9	-	5.7	1.8	-	-	-	-
Sage Thrasher	8.6	19.5	-	-	-	-	-	-
Mountain Bluebird	5.3	16.9	2.9	4.5	-	7.8	-	-
Yellow-rumped Warbler	-	-	-	-	-	26.6	-	-
Brewer's Sparrow	23.1	10.0	84.7	163.2	-	-	-	-
Vesper Sparrow	-	27.5	-	-	-	14.8	-	-
Sage Sparrow	7.7	22.9	-	-	-	8.9	-	-
White-crowned Sparrow	-	-	-	-	134.8	57.4	-	-
House Finch	37.3	20.8	7.6	13.3	-	5.3	-	-

[1] Studies conducted by Peabody (1982-1983).

TABLE 14

Bird Densities in a Tamarix Riparian Strand Habitat
In Moenkopi Wash[1]

Species	Bird Density (No./40 ha)			
	Spring	Summer	Fall	Winter
Killdeer	3.50	-	-	-
Mourning Dove	1.80	1.80	0.90	-
Northern Flicker	-	-	-	0.90
Gray Flycatcher	1.80	-	-	-
Say's Phoebe	1.80	0.60	-	-
Horned Lark	-	-	1.80	80.00
Pinyon Jay	1.20	1.80	1.80	-
Rock Wren	12.40	12.40	7.10	-
Bewick's Wren	-	0.60	3.50	0.36
Ruby-crowned Kinglet	-	-	1.80	-
Blue-gray Gnatcatcher	6.70	-	-	-
Mountain Bluebird	12.40	1.80	-	-
Northern Mockingbird	-	5.30	-	-
Sage Thrasher	-	-	1.80	-
Bendire's Thrasher	1.80	-	-	-
Loggerhead Shrike	0.60	-	1.80	-
Yellow-rumped Warbler	3.50	-	7.10	-
Warbler sp.	-	-	1.80	-
Blue Grosbeak	-	1.80	-	-
Green-tailed Towhee	1.80	-	1.80	-
Rufous-sided Towhee	-	-	1.80	-
Chipping Sparrow	0.90	3.50	-	-
Brewer's Sparrow	0.90	-	-	-
Black-throated Sparrow	5.30	12.40	-	-
Sage Sparrow	1.80	-	0.90	3.50
Song Sparrow	-	-	-	3.50
Lincoln's Sparrow	-	-	12.40	-
White-crowned Sparrow	5.30	-	128.00	42.70

TABLE 14 (Cont.)

Species	Spring	Summer	Fall	Winter
Sparrow sp.	-	-	5.30	-
Dark-eyed Junco	-	-	-	170.70
Brown-headed Cowbird	-	0.36	-	-
Oriole sp.	-	0.80	-	-
House Finch	26.60	23.10	53.30	-

[1] Study conducted by EH&A (1979-1980).

TABLE 15

Breeding Bird Densities Determined From Spot-Map Sampling of

Three Pinyon-Juniper Woodland Stands on the Black Mesa Leasehold

	SITE (NUMBER OF PAIRS/40 HA)					
	J-10		J-20		J-21	
SPECIES	1983	1984	1983	1984	1983	1984
American Kestrel	+	+	-	-	-	-
Mourning Dove	+	3.8	+	+	-	-
Common Nighthawk	+	-	+	-	-	-
Black-chinned Hummingbird	+	+	+	+	+	+
Hairy Woodpecker	+	+	+	1.9	+	3.8
Gray Flycatcher	7.6	7.6	7.6	11.5	11.5	9.5
Ash-throated Flycatcher	7.6	5.7	3.8	3.8	3.8	3.8
Scrub Jay	+	-	3.8	1.9	3.8	1.9
Pinyon Jay	+	+	+	+	+	+
Mountain Chickadee	3.8	3.8	7.6	7.6	11.5	9.5
Plain Titmouse	7.6	11.5	7.6	7.6	7.6	11.5
Bushtit	3.8	5.7	-	3.8	+	3.8
White-breasted Nuthatch	-	+	7.6	3.8	11.5	5.7
Rock Wren	+	-	-	-	-	-

TABLE 15 (Cont.)

SPECIES	J-10 1983	J-10 1984	J-20 1983	J-20 1984	J-21 1983	J-21 1984
Bewick's Wren	11.5	11.5	19.1	15.3	11.5	19.1
Blue-gray Gnatcatcher	-	+	3.8	-	3.8	3.8
Western Bluebird	-	-	+	-	3.8	3.8
Mountain Bluebird	3.8	1.9	3.8	7.6	3.8	-
Hermit Thrush	-	-	-	-	-	+
Solitary Vireo	3.8	1.9	7.6	3.8	3.8	3.8
Black-throated Gray Warbler	7.6	+	11.5	11.5	15.3	15.3
Rufous-sided Towhee	-	-	-	-	-	3.8
Chipping Sparrow	7.6	7.6	7.6	11.5	11.5	7.6
Black-throated Sparrow	+	-	+	-	-	-
Brown-headed Cowbird	+	+	+	+	+	+
House Finch	3.8	3.8	+	3.8	+	+
TOTAL DENSITY	68.5	64.8	91.4	95.4	103.2	106.7
TOTAL NUMBER OF SPECIES	21	19	21	18	19	20

NOTES:

+ Present But Density Undetermined Because of Insufficient Data.

- Not Observed During Censusing.

records, Peabody biologists determined that additional studies were warranted. Beginning in 1982, the raptor populations and their habitat requirements were studied in greater detail. A complete discussion of the raptor studies through 1984 may be found in the Vegetation and Wildlife Resources 1984 Report (Arizona Division, PCC 1985). That document discusses the regional distribution of raptors on the leasehold, red-tailed hawk nest site parameters, and red-tailed hawk prey item selection. Studies were concentrated on red-tailed hawks because this species is, by far, the most abundant raptor occurring on the leasehold.

The raptor sighting records made on and surrounding the Black Mesa leasehold from 1982 through February, 1985, are summarized in Table 16. As was previously mentioned, the red-tailed hawk is the most abundant raptor species observed. A total of 22 raptor species have been recorded, including bald and golden eagles, and peregrine falcons. Six species have been confirmed to breed on the leasehold, and nine additional species are suspected to breed. The remainder of the species are transients which are occasionally observed in migration. Known and suspected red-tailed hawk and great horned owl breeding sites are shown on Drawing 85320b.

Migratory waterfowl and shorebirds were monitored at several of the larger impoundments occurring on the leasehold in the spring of 1982 and in the spring and fall of 1983. Records were kept in discrete intervals throughout the migration seasons to quantify periodicity shown by migratory waterfowl and shorebirds. These data may be found in the Vegetation and Wildlife Resources 1983 Report (Arizona Division, PCC 1984). The results of these studies indicated that a wide range of migratory waterfowl and shorebird species visit the man-made impoundments each year. The species observed are listed in Table 1.

Mammals. The mammal species (excluding bats) recorded on or near the Black Mesa leasehold and their habitat preferences and relative abundance are listed in Table 17. The table was prepared from the quantitative sampling results and qualitative observation records collected since 1979. Twenty-six mammalian species are represented.

Erickson cruise counts for large and medium-sized mammals were conducted in conjunction with the bird transects as discussed in the methods section. Because of the scarcity of large and medium-sized mammals, density estimates have never been calculated. Occasionally, a cottontail or jackrabbit has been encountered.

TABLE 16. Seasonal, Sex, Age and Physiographic Distribution of Raptor Sightings on or Near Black Mesa (January 1982-February 1985)[1]

	Number of Sightings											
	SEASON				SEX		AGE		PHYSIOGRAPHIC SITUATION			
	W	S	Su	F	M	F	A	I	R	U	V	C
Osprey	-	5	-	1	-	-	-	-	-	4	2	-
Bald Eagle	2	-	-	-	-	-	1	1	-	-	2	-
N. Harrier	6	3	-	2	5	4	-	-	-	3	3	-
Sharp-shinned Hawk[3]	6	8	5	5	10	6	7	6	-	10	8	1
Cooper's Hawk[2]	10	10	21	6	24	10	24	11	1	30	4	3
N. Goshawk[2]	6	3	1	4	3	6	7	4	-	8	6	-
Swainson's Hawk	-	1	-	-	-	-	-	-	-	-	1	-
Red-tailed Hawk[2]	69	79	45	43	-	-	216	17	10	39	174	10
Ferruginous Hawk	-	1	-	3	-	-	-	-	1	2	1	-
Rough-legged Hawk	1	-	-	-	-	-	-	-	1	-	-	-
Golden Eagle[4]	2	-	-	-	-	-	2	-	-	-	2	-
Merlin	8	-	-	1	-	-	-	-	2	3	4	-
Peregrine Falcon	-	1	2	3	1	1	2	-	2	-	-	-
Prairie Falcon[3]	4	2	1	3	4	3	-	-	3	1	6	-
Accipter Sp.	1	1	2	2	-	-	-	-	3	2	7	-
Flammulated Owl[4]	-	-	-	1	-	-	-	-	-	1	-	-

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TABLE 16 (Cont.)

	SEASON				SEX		AGE			PHYSIOGRAPHIC SITUATION		
	W	S	Su	F	M	F	A	I	R	U	V	C
W. Screech Owl[3]	-	-	1	1	-	-	-	-	-	1	-	1
Great Horned Owl[2]	-	9	-	1	-	-	-	-	-	-	8	2
N. Pygmy Owl[3]	2	-	1	1	-	-	-	-	-	-	1	3
Spotted Owl[2]	-	2	8	3	-	-	-	-	-	-	-	13
Long-eared Owl[3]	-	2	-	-	-	-	-	-	-	2	-	-
N. Saw-whet Owl[5]	-	-	-	-	-	-	-	-	-	-	-	-

Not Listed: Turkey Vulture[3] and American Kestrel[2]

[1]Designations for Season, Sex, Age and Physiographic Situation are as follows:

[2]Confirmed Breeding

[3]Probable Breeding

[4]Historical Evidence of Breeding

[5]Possible based on literature reports

Season	Sex	Age	Physiographic Situation
W = Winter	M = Male	A = Adult	R = Reclaimed Areas
S = Spring	F = Female	I = Immature	U = Uplands (woodlands)
Su = Summer			V = Valleys (sagebrush)
F = Fall			C = Canyons

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TABLE 17

Mammals Recorded On or Near The Black Mesa Leasehold

Common Name	Scientific Name	Habitat Preference[1]	Relative Abundance[2]
Black-tailed Jackrabbit	Lepus californicus	GL,WL,S	U
Desert Cottontail	Sylvilagus auduboni	WL	U
Gunnison's Prairie Dog	Cynomys gunnisoni	GL,S	U
Rock Squirrel	Spermophilus variegatus	All,R	U
White-tailed Antelope Squirrel	Ammospermophilus leucurus	GL,SL,S	U
Colorado Chipmunk	Eutamias quadrivitattus	WL,R	C
Valley Pocket Gopher	Thomomys bottae	SL,WL,S	C
Silky Pocket Mouse	Perognathus flavus	GL, S	U
Ord's Kangaroo Rat	Dipodomys ordii	GL,S	U
Western Harvest Mouse	Reithrodontomys megalotis	GL,S	U
Deer Mouse	Peromyscus maniculatus	All	C
Brush Mouse	P. boylei	WL,R	U
Pinyon Mouse	P. truei	WL	C
Stephen's Woodrat	Neotoma stephensi	WL	C
White-throated Woodrat	N. albigula	All	U
Mexican Vole	Microtus mexicanus	GL	R
House Mouse	Mus musculus	HS	U
Porcupine	Erethizon dorsatum	WL	U
Coyote	Canis latrans	All	C
Gray Fox	Urocyon cinereoargenteus	All	R
Red Fox	Vulpes vulpes	All	U
Badger	Taxidea taxus	SL,GL,S	R
Spotted Skunk	Spilogale putorius	PJ	R
Striped Skunk	Mephitis mephitis	All	R
Bobcat	Lynx rufus	All	R
Mule Deer	Odoceileus hemionus	WL	R

[1] Symbols: GL = Grassland SL = Shrubland WL = Woodland
AA = Aquatic Associated HS = Human Settlements S = Sandy substrate
R = Rocky substrate

[2] Symbols: C = Common: Always found
U = Uncommon: Occasionally found R = Rare: Rarely found

The results of seasonal small mammal trapping studies are presented in Table 18. Trapping locations are shown in Figure 2. The results are pooled by habitat for all studies conducted on the leasehold. The sagebrush shrubland and wash terraces support the largest small mammal populations as indicated by the least total numbers of trap nights per catch. The deer mouse was the most common species encountered. The pinyon-juniper woodland also supports large populations of small mammals. The pinyon mouse was the most common species encountered in the woodland. The wash terraces and pinyon-juniper woodland tended to support the most diverse rodent populations as reflected by the total numbers of species caught. However, the pinyon-juniper woodland is the most diverse habitat because of the more equitable distribution among the species present.

Qualitative trapping in selected areas throughout the leasehold produced three additional species of small mammals that were not found in the routine trapping studies. Brush mice were found in boulder habitat along lower Reed Wash and on a rocky slope covered with pinyon and juniper in the N-14 coal resource area. The Ords' kangaroo rat was trapped in Moenkopi Wash south of the N-14 coal resource area and was observed in saltbush habitat along Reed Wash. The distribution of the kangaroo rat is limited to small areas along the channels of the major washes where alluvial substrates with textures suitable for burrowing occur. Mexican voles were trapped in reclaimed portions of the N-7/8 mining area.

The results of the seasonal spotlight surveys for mammals and other nocturnal vertebrates are presented in Table 19. The results are pooled for three survey routes established in different portions of the leasehold and surveyed in different years. The locations of the routes are shown in Figure 2. The most frequently observed species in most seasons was the blacktailed jackrabbit, followed by the desert cottontail. Observation of these species was not correlated with a particular habitat. Absolute species densities, based upon estimated spotlight coverage acreages, were not calculated because of the relatively few individuals observed in the surveys. No deer were observed in any spotlight survey.

The results of the seasonal predator scent station studies are presented in Table 20. The routes on which the scent stations were located are shown in Figure 2. The results are pooled from surveys conducted in different sections of the leasehold and in different years. None of the species that visited the scent stations can be correlated with a specific habitat, so the results were combined for all habitats in each season.

TABLE 18

Seasonal Small Mammal Trapping Results
By Habitat on the Black Mesa Leasehold[1]

Species	Numbers of Individuals Caught									
	Pinyon-Juniper Woodland		Pinyon-Juniper/ Sagebrush Transition		Sagebrush Shrubland		Sagebrush/Rabbit-brush Transition		Wash Terrace	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Whitetail Antelope Squirrel	-	-	1	1	1	-	-	-	-	3
Colorado Chipmunk	28	29	4	1	-	1	-	-	2	3
Silky Pocket Mouse	-	-	-	-	-	-	-	4	1	3
Western Harvest Mouse	-	-	-	-	-	-	-	-	4	9
Deer Mouse	20	8	40	13	150	163	10	5	244	191
Pinyon Mouse	132	167	10	5	6	7	1	-	2	-
Stephen's Woodrat	15	14	-	-	-	-	-	-	-	-
Whitethroat Woodrat	1	14	-	1	1	-	-	-	-	4
Total Catch	196	232	55	21	160	171	11	9	253	213
Total Trap Nights	650	650	200	200	450	450	196	200	648	654
Total Nights/Catch	3.3	2.8	3.6	9.5	2.8	2.6	17.8	22.2	2.6	3.1

[1] Results are consolidated from trapping studies conducted in 1979-80 by EH&A biologists, and in 1981-82 and 1983-84 by Peabody biologists throughout the leasehold.

TABLE 19

Results of Seasonal Spotlight Surveys
Conducted on the Black Mesa Leasehold[1]

Species	Numbers Observed Per Kilometer Censused			
	Spring	Summer	Fall	Winter
Desert Cottontail	0.11	0.14	0.10	0.08
Blacktail Jackrabbit	0.15	0.14	0.12	0.07
Unidentified Lagamorph	0.01	0.02	0.02	0.01
Gray Fox	0.01	0.02	-	-
Coyote	-	0.01	0.01	0.02
Unidentified Canid	-	-	-	0.01
Domestic Cat	-	0.01	0.01	-
Great-horned Owl	0.01	-	0.01	-

[1] Results are consolidated from survey routes established in three areas of the leasehold and conducted in: (1) 1979-80 by EH&A biologists (32.18 Km route replicated twice); (2) 1981-82 by Peabody biologists (16.1 Km route replicated twice); and (3) 1983-84 by Peabody biologists (18.0 Km route replicated twice).

TABLE 20

Seasonal Predator Scent Station

Results on the Black Mesa Leasehold[1]

	Visits/Scent Station Night			
Species	Spring	Summer	Fall	Winter
Coyote	0.033	0.045	10.050	0.033
Fox	0.008	0.005	0.000	0.004
Dog	0.004	0.023	0.009	0.000
Unidentified Canid	0.021	0.014	0.005	0.004
Raven	0.017	0.000	0.023	0.000
Total Visits	20	19	19	10
Total Station-nights	242	222	222	242
Total Visits/Station-nights	0.083	0.087	0.087	0.041

[1] Results are consolidated from surveys conducted in various sections of the leasehold in: (1) 1979-80 by EH&A biologists (60 or 80 station-nights depending upon the season); (2) 1981-82 by Peabody biologists (45 station-nights per season); and (3) 1983-84 by Peabody biologists (117 station-nights per season).

Coyotes were the most frequent visitors to the scent stations during all seasons. Foxes (Urocyon or Vulpes) infrequently visited the scent stations in all seasons with the exception of fall. Domestic dogs frequented those scent stations that were placed near human habitations. The winter season exhibited the least ratio of total visits per scent station nights.

The results of the seasonal aerial census for mule deer conducted in 1979 and 1980 by EH&A biologists indicated that mule deer occur in extremely low numbers in and surrounding the leasehold. This observation and the lack of ground sightings in the past six years indicated that additional aerial census work was unjustified. Only two mule deer were seen during the aerial surveys. The individuals were observed outside the lease boundary, north of the N-14 coal resource area. Personnel from the Navajo Game and Fish Program conducted aerial deer herd composition surveys in mid-January, 1983, utilizing a B-1 helicopter. The survey area included the north and east portions of the Black Mesa and a portion of Peabody's leasehold. Approximately three hours of flying time was devoted to the area. A total of 16 deer were observed in the broken hill and canyon country near the rim of the mesa. No deer were observed on or near the portion of the Peabody leasehold surveyed.

In addition to the Erickson Cruise, spotlight and aerial surveys, Peabody biologists have maintained mule deer observation records for the leasehold and vicinity since 1982. The records are provided by mine personnel such as exploration drillers, surveyors, environmental scientists, and biologists whose job responsibilities take them away from areas of concentrated human activities. Such personnel are periodically interviewed regarding mule deer sightings. Environmental Affairs personnel are required to report sightings to the recording biologist because they spend a particular amount of time in the field. Twenty-four records consisting of 47 total mule deer by 10 different observers have been made on the leasehold and vicinity. Considering just the leasehold, 12 records consisting of 18 total mule deer by 9 observers have been made. Of these, seven records consisting of nine total mule deer have been made by Peabody's Environmental Affairs personnel. Conservative estimates of the hours spent in the field over the recording period by this last group of employees exceeds 37,324 hours. This would indicate that approximately one mule deer is observed on the leasehold for each 5,332 manhours worked in the field.

The results of samples conducted in the Gunnison's prairie dog colonies which occur on the

TABLE 21

Summary of the Results of Sampling Conducted
In the Prairie Dog Colonies Found on the Leasehold

Location of Colony	Estimated Size of Colony (ha)	Active Burrows per Hectare[1]	Estimated Population Size[2]
N-14 Mining Area	19.4	102	3,949
J-7 Mining Area	2.4	-	-
J-8 Mining Area	33.7	44	2,969
Dinnebito Wash	7.9	10	160

[1]The number of active burrows/ha was determined using the point-centered quarter technique at the N-14 and J-8 colonies, and by physically marking and counting all burrows in the Dinnebito Wash colony. The J-7 colony was not sampled.

[2]Population size estimates are based upon the assumption of two prairie dogs per active burrow.

leasehold are summarized in Table 21. Four colonies were identified; three by EH&A biologists in the N-14, J-7 and J-8 mining areas, and one by Peabody biologists in Dinnebito Wash. The locations of the colonies are shown in Figure 2. The J-8 colony is the most extensive colony in terms of areal extent.

The population sizes of the colonies were estimated on the basis of two prairie dogs per active burrow. Using this assumption, the N-14 colony supports the largest population (Table 21). The Dinnebito colony supports the least population. The survey conducted in the N-14 colony occurred in 1980. The survey conducted in the Dinnebito colony occurred in 1983. The variation in numbers of active burrows per unit area, and the corresponding effects on population estimates can be attributed to the years in which the surveys occurred. Populations appear to have been decimated in the past few years, probably as a result of plague. Recent observations at the colonies first surveyed in 1980 indicates much less activity and fewer individuals sighted.

The burrows in each prairie dog colony were systematically searched for black-footed ferret sign using the procedures previously described. No evidence has been found which indicates that black-footed ferrets exist on the leasehold.

Additional mammalian species have been documented on the leasehold from observational records or other evidence. Rock squirrels are occasionally observed around rocky outcrops throughout the leasehold. Mounds made by valley pocket gophers can be found wherever loose pliable soils occur. House mice are frequent pests at revegetation seed storage areas and in buildings. Porcupine dens and sign have been observed in upper Coal Mine Wash, although none have been observed. Badger tracks have been found in the reclaimed portions of the J-7 mining area and in the vicinity of J-10. A striped skunk was observed in the sagebrush shrubland near the J-7 mining area and a road killed spotted skunk was found.

The bat species whose geographic range includes northern Navajo County, and, therefore, could potentially occur on the leasehold, are listed in Table 22. No surveys or sampling of bats has been conducted on the leasehold, although bats are occasionally seen flying near major impoundments during the late evenings of warmer months.

Reptiles and Amphibians. Reptiles and amphibians which have been recorded on or near the Black Mesa leasehold, including assessments of each species relative abundance and habitat

TABLE 22

Bat Species of Probable Occurrence on Black Mesa[1]

Common Name	Scientific Name
Yuma Myotis	Myotis yumanensis
Fringed Myotis	M. thysanodes
Long-legged Myotis	M. volans
California Myotis	M. californicus
Small-footed Myotis	M. leibii
Silver-haired Bat	Lasionyecteris noctivagans
Western Pipistrelle	Pipistrellus hesperus
Big Brown Bat	Eptesicus fuscus
Hoary Bat	Lasiurus cinereus
Spotted Bat	Euderma maculata
Townsend's Big-eared Bat	Plecotus townsendii
Pallid Bat	Antrozous pallidus
American Free-tailed Bat	Tadarida brasiliensis
Big Free-tailed Bat	T. macrotis

[1] From Hoffmeister, D.F. (1986).

TABLE 23

Reptiles and Amphibians Recorded On or Near the Black Mesa Leasehold[1]

Common Name	Scientific Name	Habitat Preference[2]	Relative Abundance[3]
Tiger Salamander	Ambystoma tigrinum	AA	R
Western Spadefoot Toad	Scaphiopus hammondi	AA	C
Woodhouse's Toad	Bufo woodhousei	A	U
Red-spotted Toad	B. punctatus	AA	R
Lesser Earless Lizard	Holbrookia maculata	GL,S	U
Collared Lizard	Crotaphytus collaris	SL,R	U
Eastern Fence Lizard	Sceloporus undulatus	GL,SL,WL,R	C
Sagebrush Lizard	S. graciosus	SL,WL,S	C
Tree Lizard	Urosaurus onatus	WL,R	U
Side-blotched Lizard	Uta stansburiana	SL,R	U
Short-horned Lizard	Phyrnosoma douglassi	SL,WL,S	U
Plateau Whiptail	Cnemidophorus velox	WL,S	U
Striped Whipsnake	Masticophis taeniatus	WL	R
Gopher Snake	Pituophis melanoleucus	All	U
Western Terrestrial Garter Snake	Thamnophis elegans	WL	R
Western Rattlesnake	Crotalus viridis	SL,WL	U

[1] Names follow Stebbins (1966).

[2]
AA = Aquatic Associated
GL = Grasslands
WL = Woodlands
SL = Shrublands
S = Sandy Substrate
R = Rocky Substrate

[3]
C = Common: Found in number
U = Uncommon: Found in small numbers
R = Rare: Occasionally found in very small numbers

preferences, are listed in Table 23. Estimates of relative abundance and habitat preference are based upon extensive field observation records. Pit-fall traps, used by EH&A in the 1979-80 studies, proved unsuccessful for determining species relative abundance.

The herpetofauna of the leasehold and surrounding area is not well represented. Only 16 species have been observed. The lizards, and particularly the Iguanidae, are the best represented groups (seven species), but only two of these can be considered common leasewide. The sagebrush lizard and eastern fence lizard were the two most widespread and abundant species observed. Snakes of all species observed are sparse. Four species of amphibians have been observed, reflecting the arid conditions of the region and lack of riparian or aquatic habitat. One amphibian, the western spadefoot toad, can be considered locally common where its habitat requirements are satisfied.

Aquatic Communities

No naturally occurring permanent impoundments or perennial streams occur on the Black Mesa leasehold. Aquatic communities consist of small, internally draining impoundments in reclaimed areas, temporary sediment ponds, freshwater ponds and MSHA impoundments. The MSHA impoundments are of primary interest because of their large size and greater value to aquatic, terrestrial and avian fauna, and aquatic and riparian vegetation.

An aquatic survey was conducted by EH&A biologists in July, 1980. Three ponds were considered; the J-7 pond, and a small catchment in the reclaimed J-3 mining area. The survey included qualitative and quantitative sampling of macrophytes, phytoplankton, zooplankton, macroinvertebrates and fishes at the J-7 pond. The smaller, temporary pond was described in qualitative terms. In addition to the biological aspects of the survey, water quality parameters were measured.

Since the 1980 survey, only qualitative assessments have been made at selected man-made impoundments. Most of the sediment control structures and internally draining reclaimed impoundments are ephemeral and lack the stability to support permanent aquatic flora and fauna. The larger MSHA impoundment do or will permanently impound water, unless removed as part of the postmining land use. The J-7 pond has existed for a sufficient period of time to develop a relatively diverse aquatic community. The other MSHA ponds have not existed long enough to stabilize, but will likely develop similarly to the J-7 pond.

TABLE 24

Fishes[1] Collected From J-7 Pond by Gill Netting and Seining, 8-10 July 1980

Scientific Name (Common Name)	Total Number	Weight (g) Range	Weight (g) Mean	Length (mm) Range	Length (mm) Mean	Sex J	Sex M	Sex F
		Gill Net						
Centrarchidae								
Lepomis cyanellus (green sunfish)	2	51.5-53.6	52.6	104-107	106			2
Micropterus salmoides (largemouth bass)	5	99.2-780.0	497.9	155-290	240		1	4
		Seine						
Centrarchidae								
Lepomis cyanellus	4	0.5-43.9	19.9	26-104	68		1	3
Micropterus salmoides	8	3.3-13.7	10.2	52-84	78		8	

[1] Common names according to Bailey et al. (1970).

TABLE 25

Estimated Density of Phytoplankton Collected From J-7 Pond[1],
8 July 1980

Taxa	Density (No./ml)
Chlorophyta	
Elakatothrix sp.	68
Gloeocystic gigas	86,602
Bacillariophyta	
Selenastrum sp.	68
Cryptophyta	
Chroomonas sp.	68
Cryptomonas sp.	204
Cyanephyta	
Anabaena sp.	68
TOTAL (No./m^2)	87,078
TOTAL TAXA	6

[1] Location of J-7 Pond shown on Exhibit 3-1.

TABLE 26

Estimated Density of Zooplankton Collected From J-7 Pond,
8 July 1980

Taxa	Density (No./ml)
Ratifera	
Conochioloides dossuarius	10
Euchlanis dilatata	5
Hexarthra mina	8
Lecane luna	85
Lecane ohioensis	3
Lepadella sp.	3
Monostyla bulla	180
Polyarthra vulgaris	3
Rotaria sp.	10
Cladocera	
Ceriodaphnia reticulata	10
Chydorus sphaericus	43
Copepoda	
Cyclopoid copepodid	30
Nauplii	480
Gastrotricha	5
TOTAL (No./l)	875
TOTAL TAXA	14

TABLE 27

Macroinvertebrates Collected by Dip Net From J-7 Pond,
8 July 1980

Taxa	Total Number
Arthropoda	
Crustacea	
Ostracode	
Cypridae	2
Insecta	
Ephemeropters	
Callibaetis sp.	1
Odonata	
Enallagma sp.	3
Ischnura sp.	8
Sympetrum sp.	3
Diptera	
Anopheles sp.	3
Chironomus riparius group	2
Mollusca	
Gastropoda	
Gyraulus sp.	22
TOTAL NUMBER	44
TOTAL TAXA	8

The in situ water quality parameters sampled in the 1980 survey included depth, temperature, dissolved oxygen, conductivity, salinity and pH. Additional chemical analysis included phosphates, nitrate, chloride, sulfate, coliform and total dissolved solids. The chemical analysis revealed that the ponds are alkaline with moderately high dissolved oxygen (EH&A 1980). Uniformly low nitrate concentrations and low coliform counts were observed. All other parameters were variable.

The fishes, phytoplankton, zooplankton and macroinvertebrates sampled in the J-7 pond are presented in Tables 24, 25, 26 and 27, respectively. The data is extracted in summary form from EH&A (1980). The method used to collect the data may be found in that document as well. The flora and fauna, except fishes, are typical of what can be expected in the larger impoundments as they develop. Fishes have been introduced in the J-7 impoundment. It is probable that fishes will be introduced in other ponds as well.

Important Wildlife Species

Categorically, important species include those that are: (1) recreationally or commercially important; (2) Federal, State and/or Tribal listed threatened or endangered; (3) raptors and other key migrants; (4) important to the well-being of a species within criteria (1), (2) or (3); (5) critical to the structure and function of the ecological system; and (6) pests.

Recreationally or commercially important species include the fur-bearers and game species hunted either for food or sport. The four fur-bearers of significant occurrence on the leasehold include the coyote, bobcat, red fox and gray fox. Commercial trapping permits are issued by the Navajo Fish and Wildlife Branch for the Black Mesa area. The Branch maintains harvest information obtained from trappers which is used for furbearer management purposes. The harvest information was summarized for the regulatory authority in the Vegetation and Wildlife Resources 1985 Report for the Black Mesa Mines (referenced in Attachment 1).

Navajo Nation game biologists have conservatively placed the adult bobcat population on the reservation at approximately 2,387 individuals (1981-1982 Navajo Reservation Bobcat Harvest Report). This estimate of one adult cat per 47.6 square miles is felt to be rather imprecise. The game biologists now place the population at 15 to 20 thousand bobcats of all age classes, which results in one cat per 5.6-7.6 square miles. Peabody's

Black Mesa leasehold is approximately 100 square miles in area. Based upon the population estimates provided by the Tribe, from 2.1 to possibly 18 bobcats could conceivably occur on the leasehold. The population estimates appear reasonable based upon the number of incidental bobcat observations that have been recorded. A portion of this population can be expected to be lost as a result of mining activities through direct mortality and loss of habitat.

Mule deer, waterfowl, mourning doves, and lagomorphs are the principle game species which occur on the leasehold. Conflicting information has been received by Peabody from various Tribal agencies regarding the status of hunting seasons, open and closed units, and legal game species in the hunting units surrounding the leasehold. To the best of Peabody's knowledge, the area surrounding the leasehold is open for hunting waterfowl, mourning doves, and desert cottontails in season. A game management unit on Black Mesa east of the study area was opened for rifle mule deer hunting in 1985. The area of Black Mesa containing the leasehold is not open to mule deer hunting and is not a specifically designated big game management unit.

The results of spotlight surveys and aerial deer surveys by Peabody Coal Company and the Navajo Tribe are discussed elsewhere in this chapter. It is clear that the mule deer population is extremely low on the leasehold. This observation is based on a sound and extensive baseline surveying effort as well as ongoing monitoring records maintained by Peabody biologists. However, habitat enhancement activities in the postmining landscape have been incorporated into the Revegetation Plan (Chapter 23) which will benefit this species.

Fifty-seven species of wildlife of known possible or probable historical occurrence on or near the Black Mesa permit area are currently on wildlife agency lists of management concern (Table 28). Of these, four are federally endangered and one is federally threatened. The following individual accounts discuss the existence of each of these species in and surrounding the permit area, and potential mining-related impacts (if any). Assessments of occurrence in the permit area are based upon field observations during the course of conducting ongoing wildlife monitoring activities and baseline studies (refer to annual wildlife monitoring reports 1981-1992).

Humpback chub (Gila cypha). The humpback chub does not occur in the permit area. The nearest population occurs in the Little Colorado River near its confluence with the

TABLE 28

Agency Listed Wildlife Species of Known, Possible or Probable Historical Occurrence on or Near the Black Mesa Permit Area

Species	Federal Status[1]	State Status[2]	Nav. Tribal Status[3]	Occurrence On BMPA[4]
Humpback Chub (Gila cypha)	E	E	2	PI
Razorback Sucker (Xyrauchen texanus)	E	E	2	PI
Western Grebe (Aechmophorus occidentalis)	HI	-	-	M2
Clark's Grebe (Aechmophorus clarki)	-	C	4	NR
American White Pelican (Pelecanus erythrorhynchos)	HI	-	-	M1
Double-crested Cormorant (Phalacrocorax auritus)	HI	-	-	M1
Great Egret (Casmerodius albus)	-	E	-	M1
Snowy Egret (Egretta thula)	-	T	-	M2
Green-backed Heron (Butorides striatus)	-	-	4	NR
Black-crowned Night-Heron (Nycticorax nycticorax)	-	-	4	M2
White-faced Ibis (Plegadis chihi)	HI	-	-	M2
Wood Duck (Aix sponsa)	HI	-	-	M1
Osprey (Pandion haliaetus)	-	T	-	M2
Bald Eagle (Haliaeetus leucocephalus)	E	E	3	M1
Northern Harrier (Circus cyaneus)	-	-	4	M/W
Cooper's Hawk (Accipiter cooperi)	HI	-	-	R+
Northern Goshawk (Accipiter gentilis)	C	C	4	R+
Swainson's Hawk (Buteo swainsoni)	C	-	4	M1
Ferruginous Hawk (Buteo regalis)	HI	T	3	M/W
Golden Eagle (Aquila chrysaetos)	EPA	-	3	R-
Merlin (Falco columbarius)	HI	-	-	M/W
Prairie Falcon (Falco mexicanus)	HI	-	-	M/W
Peregrine Falcon (Falco peregrinus)	E	C	3	M2
Sora (Porzana carolina)	-	-	4	M2
Long-billed Curlew (Numenius americanus)	C	-	4	M1
Common Snipe (Gallinago gallinago)	-	-	3	M2
Yellow-billed Cuckoo (Coccyzus americanus occidentalis)	C	T	4	NR
Barn Owl (Tyto alba)	-	-	4	NR
Flammulated Owl (Otus flammeolus)	-	-	4	M1
Northern Pygmy Owl (Glaucidium gnoma)	-	-	4	R-
Burrowing Owl (Athene cunicularia)	HI	-	-	NR
Mexican Spotted Owl (Strix occidentalis lucida)	T	T	3	R+
Long-eared Owl (Asio otus)	-	-	4	R+
Short-eared Owl (Asio flammeus)	-	-	4	NR
Belted Kingfisher (Ceryle alcyon)	-	C	4	M2
Lewis Woodpecker (Melanerpes lewis)	HI	-	-	M/W
Willow Flycatcher (Empidonax traillii extimus)	PE	E	4	M1
Hammond's Flycatcher (Empidonax hammondii)	-	-	4	M1

TABLE 28
(Continued)

Species	Federal Status[1]	State Status[2]	Nav. Tribal Status[3]	Occurrence On BMPA[4]
Tree Swallow (Tachycineta bicolor)	-	-	4	M2
Purple Martin (Progne subis)	-	-	4	M1
Black-billed Magpie (Pica pica)	-	C	-	NR
Black-capped Chickadee (Parus atricapillus)	-	-	4	NR
Marsh Wren (Cistothorus palustris)	-	-	4	M2
Loggerhead Shrike (Lanius ludovicianus)	HI	-	-	R+
Grey Vireo (Vireo vicinior)	-	-	4	R+
Yellow Warbler (Dendroica petechia)	-	-	4	M2
American Redstart (Setophaga ruticilla)	-	T	-	NR
Brewer's Sparrow (Spizella breweri)	HI	-	-	R+
Bobolink (Dolichonyx oryzivorus)	-	E	-	M1
Pine Grosbeak (Pinicola enucleator)	-	C	-	M/W
Spotted Bat (Euderma maculatum)	-	C	4	NR
Navajo Mexican Vole (Microtus mexicanus navajo)	C	T	4	R+
Black-footed Ferrett (Mustela nigripes)	E	E	2	NR
Intermountain Grey Wolf (Canis lupus youngi)	X	E	1	NR
Mountain Lion (Felis concolor)	-	-	4	M1
Rocky Mountain Elk (Cervus elephus nelsoni)	-	-	3	M1

[1] Federal Status: E = Endangered; T = Threatened; C = Candidate; HI = High Federal Interest; EPA = Bald and Golden Eagle Protection Act; PE = Proposed Endangered

[2] State Status: E = Endangered; T = Threatened; C = Candidate; X = Extinct

[3] Navajo Tribal Status: 1 = Extirpated; 2 = Endangered; 3 = Threatened; 4 = Candidate

[4] Occurrence on Black Mesa Permit Area (BMPA) (observation period from 1979 - 1993): PI = outside BMPA but in situation(s) of potential impacts; M1 = migrant or transient occurrence, less than 10 records; M2 = migrant or transient occurrence, 10+ records; M/W= migrant/transient, winter occurrences; R- = resident, breeding unconfirmed; R+ = resident, breeding confirmed; NR = no records.

Colorado River near Grand Canyon. Other populations occur in the Colorado River in Grand Canyon, Westwater, and Debeque Canyons of the Colorado River, Desolation and Gray Canyons of the Green River, and Yampa and Whirlpool Canyons in Dinosaur National Monument (58 FR 6578).

The humpback chub is found in remote river canyons where they utilize a variety of habitats, including pools, riffles, eddies, and rapids (58 FR 6578). These habitat requirements are not met within or proximate to the leasehold. The USFWS expressed concern that mining-related surface water depletions in the Moenkopi and Dinnebito drainages, both tributary to the Colorado River, might reduce streamflow in the Little Colorado. However, OSM's cumulative hydrologic impact assessment shows that no detectable decrease in discharge has occurred from mining in the Moenkopi drainage (Final Environmental Impact Statement, Proposed Permit Application, Black Mesa-Kayenta Mine, Navajo and Hopi Indian Reservations, Arizona, OSM-EIS-25, 1990). Less interception of flow will occur in the Dinnebito Wash. Therefore, no adverse affects from surface mining will occur on this species.

Razorback sucker (Xyrauchen texanus). The razorback sucker does not occur in the permit area. The nearest known population is located at the mouth of the Little Colorado River. As with the humpback chub, no hydrologic impact will occur which will adversely affect this species.

Western Grebe (Aechmophorus occidentalis). This species is characterized as an uncommon migrant on the leasehold (see Table 1). All observation records are from the J-7 impoundment. Most of the observations were made in the months of April and October. The potential impacts of surface coal mining on western grebes are related to disturbances of nesting habitat (FWS/OBS-83/35). Since western grebes are migratory on the leasehold in small numbers, no impacts are expected.

Clark's Grebe (A. clarki). No Clark's grebes have been observed on the leasehold, thus no impacts are expected

American White Pelican (Pelecanus erythrorhynchos). This species is a rare migrant on the leasehold (see Table 1). Four individuals were observed at the J-3 reclaimed area on October 18, 1984. All remaining observations are from J-7 pond and consist of five observations totaling about 280 individuals. No mining-related impacts are expected to affect this species due to its rare migratory status.

Double-Crested Cormorant (Phalacrocorax erythrorhynchos). One record: an immature was present at Pond KMFWP 17-24 August 1990. Because of its sparse transitory status, no mining-related impacts will affect this species.

Great Egret (Casmerodius albus). One record: a single bird was observed at J-7 pond from 25 September - 1 October 1990. Because of its sparse transitory status, no mining-related impacts will affect this species.

Snowy Egret (Egretta thula). Snowy egrets are relatively common migrants at ponds throughout the Black Mesa leasehold. No mining-related impacts will adversely affect this species due to its migratory status and lack of breeding populations.

Green-Backed Heron (Butoroides striatus). This species occurs as a sparse migrant throughout the Navajo Nation (Jacobs 1986). No records have been made in the Black Mesa permit area. No mining-related impacts will occur to this species.

Black-Crowned Night-Heron (Nycticorax nycticorax). A rare migrant with most of the 13 records from J-7 pond. No mining-related impacts will affect this species.

White-faced Ibis (Plegadis chihi). This species is an uncommon migrant at ponds throughout the leasehold (see Table 1). Most records are made in the months of April, May, August, and September. Surface coal mining impacts are related to potential nesting habitat disturbance (FWS/OBS-83/35). No major impacts on this species are expected to occur at the Black Mesa mining complex because of its migratory status.

Wood Duck (Aix sponsa). This species is a rare migrant (see Table 1) having been observed only once at the J-7 impoundment on December 6, 1985. Potential impacts from surface coal mining have been identified as breeding site disturbances (FWS/OBS-83/35). No impacts will occur on this species as a result of surface mining activities on the Black Mesa leasehold.

Osprey (Pandion haliaetus). This species is a regular migrant throughout the permit area in small numbers. No mining-related impacts will affect this species due to its migratory status.

Bald eagle (Haliaeetus leucocephalus). Bald eagles have been sighted within the boundary of the leasehold on three occasions. Bald eagle sighting reports were filed with the Navajo Fish and Game Program, as per their procedures. This species occurs as a resident along the Salt and Verde Rivers in central Arizona, but is of transitory status in northern Arizona (Phillips et al. 1964). Occasional sightings of migrating eagles can be expected throughout the Black Mesa region, especially in early winter. Although an occasional migrant may transit the area, the Black Mesa/Kayenta Mine leasehold exhibits minimum utility for this species and no impacts are expected.

Northern Harrier (Circus cyaneus). This species is a migrant and will winter on the leasehold. Harriers are most frequently seen using reclaimed areas. Since the reclaimed lands are beneficial to this species and no nesting sites are known, mining-related impacts will not occur.

Sharp-Shinned Hawk (Accipiter striatus). This species is primarily a migrant on the permit area. Although nesting rarely occurs in pinyon-juniper in northeastern Arizona (Woodbury and Russell 1945), no known nesting has been documented in the permit area. Because of its migratory status, no mining-related impacts will affect this species.

Cooper's Hawk (Accipiter cooperi). The Cooper's hawk has been characterized as an uncommon permanent resident on the Black Mesa leasehold (see Table 1). It is more numerous as a migrant. This species breeds in the mixed conifer woodland habitat. Small numbers nest in dense stands of pinyon-juniper woodland on the leasehold. The Cooper's hawk is primarily an inhabitant of woodland habitats. This species will be eliminated from those tracts of pinyon-juniper woodland that will be disturbed by surface mining activities on the leasehold. Based upon the observation records, an optimistic estimate of five pairs may be lost.

Northern Goshawk (Accipiter gentilis). This species is characterized as a sparse transient and winter resident in the permit area. Breeding likely took place at one site in pinyon-juniper woodland in the J-21 mining permit area in 1988 and breeding was confirmed there in 1993. Since no other evidence of breeding has been noted, perhaps only this single pair will be eliminated as a result of mining activities. The migrant and wintering population will not be adversely affected by mining activities.

Swainson's Hawk (Buteo swainsoni). Swainson's hawks are rare migrants (six total records). Because of this species' sparse migratory status, no mining-related impacts will occur.

Ferruginous Hawk (Buteo regalis). This hawk is an uncommon migrant and winter resident most frequently seen using reclaimed areas. An open country raptor that exploits the reclaimed landscape, this species will not experience negative mining-related impacts.

Golden Eagle (Aquila chrysaetos). Golden eagles are of sparse, irregular occurrence as transient individuals. Evidence exists of nearby breeding birds exploiting locally or temporally abundant prey (i.e., prairie dogs) in the permit area. No negative mining-related impacts will affect this species.

Merlin (Falco columbarius). This species is a rare winter resident on the leasehold from late October to mid-February (see Table 1). It prefers open habitats. Major surface coal mining impacts are related to breeding areas (FWS/OBS-83/85). The status of this species on the leasehold precludes the potential for impacts. The establishment of open landscapes in the reclamation process will benefit this species. Twenty-one of the thirty-four Merlin records collected on the leasehold were near or from reclaimed areas.

Prairie Falcon (Falco mexicanus). This species has been characterized as an uncommon permanent resident (see Table 1) although no pairs are known to nest on or near the leasehold, and the observation records thus far obtained do not suggest breeding. Given the status of this species, the lack of evidence regarding nesting, and that potential nesting cliffs will not be disturbed by mining activities, potential mining related impacts can be considered minimal.

Peregrine Falcon (Falco peregrinus). While still listed as endangered by the USFWS and the Navajo Tribe, this species has been down-listed to a candidate species by the Arizona Game and Fish Department because of substantial population increases throughout the State. The 11 permit area occurrences are comprised exclusively of transitory individuals.

In Arizona, nesting peregrines require extensive cliff formations that are of great height, and which may or may not be situated near bodies of water. These general habitat requirements are met along the escarpment that forms the north and east ends of the Black Mesa. The leasehold and vicinity lacks such habitat, and consequently, peregrines are

absent as a breeding species or frequently observed migrant. The small number of sightings supports the conclusion that peregrines infrequently utilize habitats on the leasehold. It is interesting to note that several of the birds observed on the leasehold were over reclaimed areas. In one case, they were observed hunting horned larks which are very abundant on the reclamation. In another instance, they were observed hunting ducks on several small internally draining impoundments in a reclaimed area. Perhaps the open character of the reclaimed areas and additional amounts of surface water are of potential benefit to the peregrine falcon. The long-term effects of disturbance of the pinyon-juniper habitat on peregrines will be minimal given the rare transitory status of this species on and near the leasehold and the distance between the disturbance areas and the nearest potential breeding habitat.

Sora (Porzano carolina). The sora is a sparse migrant. The 15 records are all from ponds. No negative mining-related impacts will affect this species.

Long-billed Curlew (Numenius americanus). This species is a rare migrant (see Table 1 - four records from April, May, June, and August). Surface coal mining impacts are reported to be associated with nesting habitat (FWS/OBS-83/35). Impacts on this species will be negligible at the Black Mesa complex because of its sparse transitory status.

Common snipe (Gallinago gallinago). This species is a sparse migrant on the leasehold. Its transitory status precludes adverse impacts from surface mining activities.

Yellow-Billed Cuckoo (Coccyzus americanus occidentalis). There are no records from the leasehold. Although a sparse transient on the Navajo Nation (Jacobs 1986), the absence of well developed cottonwood-willow riparian vegetation on the permit area precludes negative mining-related impacts.

Barn Owl (Tyto alba). There are no records from the leasehold. Its scarcity on the Navajo Nation (Jacobs 1986) and lack of any individuals in the permit area preclude negative mining-related impacts.

Flammulated Owl (Otus flammeolus). There are two records (transients) from the permit area. A lack of suitable breeding habitat (ponderosa pine-oak woodland) and the transitory status of this species preclude negative mining-related impacts.

Northern Pygmy-Owl (Glaucidium gnoma). This species appears as a resident in mixed conifer woodland near the permit boundary. Lack of disturbance to that habitat type precludes negative mining-related impacts.

Burrowing Owl (Athene conicularia). There are no records from the Black Mesa leasehold. Although suitable appearing habitat exists in the permit area, the absence of any individuals preclude negative mining-related impacts. The reclaimed areas offer potentially exploitable habitat for this species.

Mexican Spotted Owl (Strix occidentalis lucida). This species was recently listed by the USFWS as threatened. A small population of spotted owls has been monitored by Peabody in mixed conifer woodlands adjacent to the Black Mesa permit area.

Little is currently known about the habitat requirements of the Mexican spotted owl. Suitable habitat characteristics described by the USFWS include: 1) mid-aged, mature, and old forest habitats with multiple canopy layers, moderately closed to closed canopies, a component of large-statured trees, and presence of standing dead and down woody material; and 2) forested and non-forested canyons with rock walls and steep slopes. Nesting habitat is provided by stands with high tree density, and a great degree of canopy closure. Nesting owls utilize stands varying from a few acres to over 50 acres in size. Suitable habitat characteristics exist near the north and east rim of the Black Mesa in the mixed conifer woodlands (see Chapter 10, Page 14 and Chapter 9 for a description of this habitat). The mixed conifer woodlands typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Distribution of the habitat is controlled by topography, aspect, and elevation. Fragmented stands occur north and east of the permit area with more extensive, continuous stands as elevation increases and topography becomes rougher as one proceeds further north and east of the permit area. Drawing 85320a shows the mixed conifer woodland in the permit area and within a two-mile buffer area around the permit area boundary.

The first documentation of Mexican spotted owls on northern Black Mesa occurred in 1982 when molted feathers were found under a roost tree. The first nesting pair (Site 1) was found on June 24, 1983. A second pair was observed in 1984 and 1985, and their nest site was located on April 11, 1986 (Site 2). A third nest site was located in May, 1986 (Site 3). Site 2 is the first confirmed breeding site located within two miles of the lease boundary. During the period of record, molted feathers have been found in numerous other canyons where mixed conifer woodland is prevalent.

The occupancy of nest Sites 1 through 3 has been variable (Table 29). Sites 1 and 2 have undergone long periods of inactivity (five and six years, respectively). Site 3 has been active for seven consecutive years.

In the process of mapping and evaluating potential habitat in 1993, single owls were found in six new localities (Sites 4, 5, 6, 10 and 11). All of these observations were within two miles of the leasehold. Subsequent checks for nests resulted in confirmed breeding at Site 5. Site 5 is the second nest site documented within two miles of the permit boundary. Site 9 is an owl nest site used in 1993 whose owners have yet to be determined. Outside of the two-mile buffer, a fifth confirmed breeding site (Site 7) was located along with another possible breeding locality (Site 8).

Ganey (1992) found that woodrats comprised 81.7 percent of the prey biomass from a sample of Mexican spotted owl pellets collected on Black Mesa. Woodrats are common prey for the owls elsewhere in Arizona (Ganey, 1992).

Historical mining-related disturbances range from 1.9 miles to 4.5 miles distant from the observation and nesting sites (Table 30). Projected mining disturbances will approach to within 1.4 miles of Site 5 and 1.6 miles of Site 9 with mining at N-10 and N-11 in the year 2003 and 1994, respectively (Table 30). Habitat disturbances unrelated to Peabody's mining operations (e.g., brush control, pinyon-juniper chainings, livestock pond construction) have occurred within close proximity to most sites.

The mixed conifer woodland habitat differs significantly from the pinyon-juniper woodland habitat occurring on and near the permit area in several respects (Table 31). These differences help to explain why the Mexican spotted owl utilizes the mixed conifer woodland habitat for breeding, roosting, and foraging; with apparently no or limited use of the pinyon-juniper habitat on and near the permit area. This observation is supported by the fact that all Mexican spotted owl observations made to date on the Black Mesa have been in mixed conifer woodland habitat, or in isolated instances, in areas immediately adjacent to such habitat. The six known or suspected Mexican spotted owl breeding sites are all located in canyons supporting mixed conifer woodland. The mean elevation at which these sites are located is 7080 feet (range = 6880 to 7200 feet) in canyons averaging approximately 175 feet deep (range = 120 to 240 feet). In addition, all confirmed nest sites are located in potholes and caves.

Little suitable Mexican spotted owl habitat occurs within the permit area. No direct disturbance of breeding habitat will occur. Suitable habitat does occur within two miles of the permit area. After 21 years of mining activities, the Mexican spotted owl continues to successfully breed in preferred habitat adjacent to the leasehold, apparently in relatively close proximity. This gives evidence to the fact that the mining activities have not adversely impacted this species.

No potential exists for direct mining-related impacts on the Mexican spotted owl population because no suitable breeding habitat will be disturbed. The potential may exist for indirect impacts; however, these impacts would be slight due to the distance between operational activities and known or suspected breeding areas. Consideration of blasting as a possible mining related impact has been raised. However, the buffering effects of distance and topography greatly reduce the potential for disturbance to the birds (see Attachment 3). Furthermore, the work of Holthuijzen et.al. (1990) who concluded that "blasting associated with limited human activities does not need to be restricted at distances less than 125 m from occupied prairie falcon aeries, provided that peak noise levels do not exceed 140 dB at the aerie and no more than 3 blasts occur on a given day or 90 blasts during the nesting season" and Ellis et.al. (1991) who states "...responses to real and simulated mid- to high altitude sonic booms were often minimal and never appeared productivity limiting" to breeding raptors indicates that the blasting (which will occur no closer than ca 7400 feet) will have a negligible effect on the owls. Additionally, the population of spotted owls on Black Mesa has been exposed to distant mining related blasting for greater than 20 years and cannot be considered a population naive to this disturbance. Also, this subspecies has apparently evolved in the American southwest in the presence of a strongly developed monsoon season (during the breeding period) that is typified by frequent convectional storms that may generate considerable lightning activity and associated thunder. This raises the possibility that the Mexican spotted owl may, in reality, possess a high tolerance to noise disturbances similar to thunder, such as distant blasting.

Peabody intends to obtain additional information on the Black Mesa spotted owl population. This effort will include: 1) estimating the population size; 2) analysis of food habits; and 3) determining breeding success. The information will be reported to the regulatory authority on an annual basis for use in assessing potential impacts. If impacts are identified, appropriate consultation and planning will be undertaken to mitigate impacts and protect the species.

TABLE 29

Historical Occupancy of Five Spotted Owl
Nest Sites on Northern Black Mesa, Navajo County, Arizona

Nest Site	
1	Pair seen 24 June 1983, 20 June 1984, 14 September 1984. Molted feathers found 14 June 1985. No evidence of occupancy 1 July 1985 to 20 June 1989 when old molted feather found. Signs of recent occupancy seen 24 May 1990. Bird seen in cave 30 April 1991. Pair seen 26 March 1992. One adult with two fledged young seen 18 June 1992. Adult pair seen 20 April 1993.
2	Pair seen in area 18 September 1984, 2 August 1985. Breeding in 1986 (one young) and 1987 when two young found dead in nest and no sign of adults in area on 11 June. No evidence of occupancy seen until 20 April 1993 when two adults were seen.
3	Site occupied 1986 through 1993 with young (two) seen in site on 9 June 1986, 12 June 1987, one fledgling seen 22 June 1992, and female in cave on 20 April 1993.
5	Site occupied in 1993 (female observed incubating on 6 May 1993). Nest site located in small cliff.
7	Site occupied in 1993 (female observed incubating on 6 May 1993). Nest site located in large cliff.

TABLE 30

Summary of Spotted Owl Observations and Nest Sites

in Relation to Surface Mining and Other Disturbances

Site	Site Name	Within Buffer?	Confirmed Breeding Locality?	Distance to Permit Boundary (miles)	Approx. Distance to Projected Disturbance	Distance to Prior Mine Disturbance	Distance to Prior Non-Mine Habitat Disturbance (miles)[2]
1	Owl Canyon	No	Yes	2.6	3.5	2.6	1.0
2	Corral	Yes	Yes	1.7	3.0	3.4	0.9
3	Brushy	No	Yes	3.4	4.9	3.6	0.3
4	Labyrinth	No	No	2.0	4.1	2.1	300 ft
5	Scoria	Yes	Yes	0.3	1.4	2.0	0.6
6	Hidden	Yes	No	1.6	4.5	1.9	0.3
7	Alcove	No	Yes	2.4	3.6	4.3	0.3
8	Horsetail	No	No	4.1	5.2	4.5	0.9
9	First Fir	Yes	No[1]	0.8	1.6	1.9	1.5
10	Pillar Cave	Yes	No	1.1	2.8	2.8	0.9
11	Wager	Yes	No	1.9	2.8	2.9	0.9

[1] Tree nest site occupied by an undetermined owl species (c.f. spotted or long-eared) in 1993.

[2] Includes intense exploratory drilling activities

TABLE 31

Habitat Attribute Comparison Between Mixed
Conifer Woodland and Pinyon-Juniper Woodland

Attribute	Mixed Conifer Woodland	Pinyon-Juniper Woodland
Component of large trees (e.g., Douglas fir, ponderosa pine)	Yes	No
Community restricted to north-facing slopes and canyons	Yes	No
Restricted to elevations >6800 feet	Yes	No
Consistent presence of deciduous shrub understory (*Quercus*, *Ribes*, *Fendlera*)	Yes	No
Cliff formations (≥ 20 feet high containing potholes, crevices)	Yes	No
Presence of large snags > 35 feet in height	Yes	No
Consistent presence of large boulders and rubble zones	Yes	No
Multiple canopy layers	Yes	No
Moderately closed to closed canopy	Common	Uncommon
Downed woody material	Common	Uncommon
Persistent surface water (e.g., seeps, springs, potholes)	Common	Extremely Rare

The monitoring plan is proposed to ensure that the Mexican spotted owl is being adequately protected. The intensity, methods, study area, and objectives of the monitoring plan are consistent with the level of impact that may occur. The objective of the plan is to monitor the breeding population of Mexican spotted owls on and near the permit area. Monitoring will consist of tracking the reproductive output of the owls over time by checking nest site occupancy and productivity. These data will be compared with known and/or modeled values from other Mexican spotted owl populations to determine if the Black Mesa population is reproducing at levels sufficient to maintain itself. All known or suspected breeding localities near the permit area (Table 30) will be visited early in the breeding season (March, April) to determine if the sites are being used in the particular study year. Subsequent visits, later in the breeding season, will be made to those sites that are occupied to determine the number of young that fledge. Productivity checks will be timed so that counts are made when the chicks are near fledging (approximately 30 days in age).

Within the two mile buffer, the six known sites will be visited in March/April to determine if birds are present. Following this initial check, nocturnal survey stations will be selected to effect a complete coverage survey following USFS protocol of all remaining suitable habitat (mixed conifer woodland) and those sites where birds were not initially located within the two mile buffer. Outside of the two mile buffer, only those previously identified sites will be monitored using the diurnal monitoring techniques that have been previously followed. Such methodology has proven very effective on Black Mesa and has, in fact, resulted in the discovery of all but one of the sites identified thus far (see Table 30).

Nocturnal surveys following the U.S. Forest Service protocol, will also be conducted annually for a five-year period at and adjacent to the N-11 mining area starting in 1994. Initially, ten to twelve survey stations will be located in the mining area and at intervals extending outside the mining area toward known suitable habitat. Once mining disturbances begin, the survey stations located in the disturbance area/suitable habitat buffer area (six to eight in number) will continue to be monitored for the remainder of the five-year period (1995 to 1998). Nocturnal surveys will be conducted at and near the N-10 mining area starting two years prior to scheduled disturbance (2001) and for three years thereafter. Sampling design will be the same as that utilized previously at N-11.

An estimate of the population size in the permit area and within the two-mile buffer will

be made each year based upon the sum of all owls counted during the breeding and supplemental surveys. Each bird found will be sexed and aged, if possible, using known plumage and molt sequences. The age structure data may have important implications for insular spotted owl populations (Gutierrez and Prichard, 1990) which the one on northern Black Mesa may be.

Prey habits will be studied using pellet content analysis from pellets collected at known roosts and nest sites. General prey preferences are known for this subspecies. Annual reproductive output is probably related to prey abundance, similar to other raptors on the Black Mesa. Pellet analysis may indicate if a particular prey species or species group is being heavily utilized during good or poor reproductive years.

The study information will be reported to the regulatory authority on an annual basis for a period of five years beginning in 1995. The results will be used to assess the status of the population, and detect unusual fluctuations (i.e., population declines) in the population. It is emphasized that unusual fluctuations may not be attributable to the effects of mining. In the event that the population behaves unusually, additional studies designed to determine the cause of the population changes would be warranted. Such additional studies would be undertaken in consultation with OSMRE. The five-year monitoring period will be extended, if deemed necessary by the regulatory authority on the basis of the results obtained during the first five years.

Long-eared Owl (Asio otus). The status of this species on and surrounding the leasehold is uncertain (six records of which two were victims of predators). Breeding occurred in pinyon-juniper woodland in the J-21 mine permit area in 1990. Although rare, the breeding record indicates that at least one breeding pair will be eliminated due to mining activities. One record is currently from a reclaimed area. Since this species forages over open terrain, the reclaimed areas offer potential feeding habitat. Mining-related impacts are expected to be minor given the number of records, and will be offset by the reestablishment of beneficial habitat.

Short-eared Owl (Asio flammeus). Although known from a few records in northeastern Arizona (Jacobs 1986), the absence of this species from the permit area (no records) precludes negative mining-related impacts. The reclaimed areas provide potential foraging habitat for this species.

Belted Kingfisher (Ceryle alcyon). This species is a fairly common migrant in the permit area. Lack of suitable breeding habitat preclude negative mining-related impacts.

Lewis' Woodpecker (Melanerpes lewis). This species is a rare migrant (one winter record). Lack of suitable breeding habitat in the permit area precludes negative mining-related impacts.

Willow Flycatcher (Empidonax traillii extimus). The USFWS currently proposes to list the "southwestern" subspecies as endangered. No Willow Flycatchers are known to breed on or near the permit area. Suitable habitat of cottonwood-willow or tamarisk with permanent flowing water is absent on or near the permit area. Recent breeding season bird censusing of such habitat along intermittent reaches of surface water on the leasehold have revealed no Willow Flycatchers (data not reported). No downstream surface water impacts from the Black Mesa complex will occur in the small reach of proposed critical habitat on the Colorado River downstream from the confluence of the Little Colorado River (Final Environmental Impact Statement, Proposed Permit Application, Black Mesa-Kayenta Mine, Navajo and Hopi Indian Reservation, Arizona, OSM-EIS-25, 1990). The five records totalling six birds noted in the permit area, are all likely migrant individuals of more northerly subspecies.

Hammond's Flycatcher (Empidonax hammondii). This species has been characterized as a common migrant in northeastern Arizona (Monson and Phillips 1981). It breeds in spruce-fir forest. Such habitat does not occur in the permit area, precluding potential adverse mining-related impacts.

Tree Swallow (Tachycineta bicolor). Tree swallows are common migrants. Lack of suitable breeding habitat (montane, aspen/conifer forest) in the permit area preclude negative mining-related impacts.

Purple Martin (Progne subis). This species is migrant (only two records on or near the leasehold). Lack of suitable breeding habitat (montane forest) in the permit area preclude negative mining-related impacts.

Black-billed Magpie (Pica pica). There are no records for this species from the leasehold. Lack of suitable breeding habitat (well developed riparian vegetation) preclude negative mining-related impacts.

Black-capped Chickadee (Parus atricapillus). This species is caracterized as a sparse winter visitor to the Navajo Nation in tamarisk and aspens (Jacobs 1986). Since tamarisk vegetation on the leasehold will not be disturbed, no mining-related impacts are expected. Marsh Wren (Cistothorus palustris). Marsh wrens are fairly common migrants at ponds on the leasehold. Lack of a breeding population precludes negative mining-related impacts.

Loggerhead Shrike (Lanius ludovicianus). The loggerhead shrike is an uncommon permanent resident of open grasslands and shrublands on the leasehold (see Table 1). The establishment of open landscapes in the reclamation process will benefit this species. The shrub planting program (Chapter 23) will be of added benefit by providing nesting and perching habitat.

Grey Vireo (Vireo vicinior). This species is an uncommon summer resident breeding on open pinyon-juniper covered slopes with a tall shrub understory. Although some pairs will likely be lost due to mining activities, no overall adverse impacts to this species will occur due to mining activities.

Yellow Warbler (Dendroica petechia). Yellow warblers are common migrants in riparian situations. Lack of a breeding population and disturbance to tamarisk vegetation precludes negative mining-related impacts.

American Redstart (Setophaga ruticilla). There are no records from the leasehold. Lack of a breeding population precludes negative mining-related impacts to the species.

Brewer's Sparrow (Spizella breweri). The Brewer's sparrow is a common summer resident of sagebrush and saltbush shrubland habitat from April to October on the leasehold (see Table 1). It also has been documented to breed. It is a common migrant in tamarix riparian strand habitat and adjoining greasewood shrubland. Variously derived densities have been estimated (Tables 6, 7, 10, 11, 12, 13, and 14; and Tables 4-4 and 4-5 in Western Division, P.C.C., 1986). The estimated leasewide breeding population (premining) can be expected to decline as a result of surface mining activities on the leasehold. The shrub planting program (Chapter 23) will provide suitable nesting habitat in the reclaimed areas. Brewer's sparrows have been documented to breed in reclaimed shrublands on the leasehold (Western Division, P.C.C., 1986). Given the regionally extensive range of this species and the benefits of shrub reestablishment in the reclaimed areas, surface coal mining impacts on the Black Mesa on Brewer's sparrows and several other shrubland sparrows will be minimal.

Bobolink (Dolichonyx oryzivorus). This species is a migrant with only one record from the leasehold and vicinity. Lack of a breeding population precludes negative mining-related impacts to this species.

Pine Grosbeak (Pinicola enucleator). One record has been logged from mixed conifer woodland habitat. Lack of suitable breeding habitat (spruce-fir forest, Monson and Phillips 1981) precludes negative mining-related impacts to this species.

Spotted Bat (Euderma maculata). This species inhabits the ponderosa pine belt to the lower sonoran life zone in Arizona, preferring crevices in rocky cliffs and canyons. Its distribution is considered to be statewide, although the only records are from central and southwestern Arizona. The spotted bat is not currently listed as endangered or threatened in Arizona. Mr. David Rowe of the Arizona Game and Fish Department has indicated that insufficient information exists on this species for the Department to make a determination as to its status. No specific surveys for bats were conducted on the leasehold. However, habitat of potential use by this species occurs in the leasehold and along the rim of Black Mesa.

Mexican Vole (Microtus mexicanus). The Mexican vole is distributed at higher elevations in northern and north-central Arizona. It prefers open park-like habitats and mountain meadows. Voles have been found throughout the leasehold in reclaimed lands and in tamarisk stands along Moenkopi Wash. This population is of scientific interest since it is possibly a relic isolate. Reclamation practices in place on the permit area have benefitted this species. As more land is reclaimed, this vole will continue to increase within the permit area.

Black Footed Ferret (Mustela nigripes). Ferrets are known to have previously existed in northern Arizona (Hoffmeister 1986), although no records are known for at least the past 20 years. Field surveys did not reveal any evidence of this species' presence in the prairie dog towns located on the leasehold. The possibility that ferrets occur in the study area or in the remainder of the leasehold remains extremely remote.

Intermountain Grey Wolf (Canis lupus youngi). Perhaps this species formerly occurred in the permit area. Since this form is extinct, no mining-related impacts will occur.

Mountain Lion (Felis concolor). The only documentation of this species on or near the

leasehold consists of tracks found in the J-21 mining permit area in September 1993. This individual was likely dispersing from established populations elsewhere. Its persistence in the permit area is unlikely due to low densities of mule deer. No adverse impacts due to mining activities will occur.

Rocky Mountain elk (Cervus elaphus nelsoni). The elk is listed in Group III of the Endangered Species List for the Navajo Nation. The Navajo Natural Heritage Program has expressed concern about this species because of its potential to occur on the mine permit area. Distribution and numbers of Rocky Mountain elk are limited on the Navajo reservation primarily because of lack of suitable habitat.

The Rocky Mountain elk could potentially occur throughout the permit and adjacent areas, in all vegetation types. The presence of elk within the permit area was not documented until 1992. Tracks of approximately three individuals were seen at a pond near the N-14 mining area on July 30, 1992. On December 10, 1992, a single female was tracked from reclaimed lands in the N-14 mining area into adjoining pinyon-juniper woodland. This animal may have been poached on December 12, 1992.

The source of these animals is unknown, and they may be exotic to the Black Mesa area. No occurrence of this species was documented in any of the extensive faunal analysis conducted in association with the Black Mesa Archaeological Project, and no sightings were made during the course of conducting the wildlife baseline studies. Navajo Tribal Fish and Wildlife personnel have indicated that some animals may have immigrated from southwestern Colorado via the Chuska Mountain range. Elk are also known to have entered the Navajo reservation from the south and southwest, and have been observed in District 6 of the Hopi reservation. The occurrence of Rocky Mountain elk on Black Mesa may be the result of pronounced range expansion due to population growth in surrounding areas.

Mining and reclamation activities will not adversely impact the Rocky Mountain elk. The population on northern Black Mesa is apparently small, and extensive tracts of suitable habitat exist on and surrounding the permit area that are not fully occupied. The reclamation and pond construction associated with mining are of potential benefit to this species. The grass-dominated reclaimed areas and ponds will provide feeding and watering sites adjacent to cover supplied by the pinyon-juniper woodland.

Most of the above-discussed species are transitory in the study area and no negative mining-related impacts will occur to their populations and/or habitats. Several mining-related habitat changes may or will be of benefit to several of these species. Examples of such include pond and marsh habitats associated with sediment impoundments (utilized by egrets, the marsh wren, and sora) and reclaimed lands (used by at least eight of the raptors in Table 28). For the remaining species that may/will undergo some negative impacts (e.g., loss of Cooper's Hawk breeding sites), these losses will not be significant due to the small numbers involved and/or their large geographic ranges. For those few species where sufficient regulatory concern has been raised, monitoring plans are in place or are proposed (see Spotted Owl above, the raptor monitoring plan on pages 77 to 78 of this chapter, and the Peregrine Falcon and Black-Footed Ferret plans in Attachment 2 of this chapter). It should also be noted that statements of concurrence from the United States Fish and Wildlife Service regarding the Technical Environmental Assessments of three previous permit applications have been received by Peabody in the permit approval package.

Several raptors and other migratory species utilize various resources within the lease area, although none can be considered of "key" importance to the structure and function of the ecosystem. No migration corridors were observed in the study area, nor are any known to occur over the remainder of the leasehold.

The reconnaissance for raptor nests revealed that the lease and surrounding region supports fairly abundant populations of raptors, especialy red-tailed hawks. Although habitats within the study area are not unique for raptor feeding, roosting, or nesting, they must be considered important as indicated by the numbers of active nests found.

No species found within the leasehold fall within criteria (4) and (5) outlined at the beginning of this section. All of the above-discussed taxa have varied food habits and do not depend solely on another single species, although a change in the abundance of one species probably results in compensatory changes in other species' populations.

Several wildlife species in the Black Mesa region fall into the category of pests. This

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is due in part to cultural practices in the area. Small rodents (Neotoma, Peromyscus and Eutemias) have been reported to enter dwellings and eat or damage food stores, clothing and other materials. Coyotes, feral dogs and bobcats have been reported to occasionally kill sheep or lambs and are probably shot on sight. Rabbits, rodents and ravens occasionally damage cultivated crops.

Important Habitats

The habitat types found on the Black Mesa leasehold and surrounding area are represented throughout the Great Basin and Colorado Plateau regions of the southwestern United States. No naturally occurring wetlands occur within the study area. No habitats on the leasehold can be considered critical to the continued existence of any Federal, State or Tribal listed threatened or endangered wildlife. Most of the species involved are uncommon transients, and none can be considered endemic to the area. No bald or golden eagles nest in or immediately surrounding the leasehold. No wildlife migration routes were identified during the course of conducting the baseline studies.

Four habitats or habitat features can be considered to be of high value to specific wildlife groups relative to the overall environment on the leasehold. The designation of these habitats as valuable is based upon: 1) the limited occurrence of the type or feature locally; 2) the importance of the type or feature to important species; and 3) utilization of the habitat type or feature by an unusually great number of wildlife species. The habitats and habitat features identified as such include the mixed conifer woodland, tamarix riparian strand, the J-7 impoundment, and cliffs, bluffs and talus slopes.

The distribution of the mixed conifer woodland habitat in the study area is limited to the northeastern section in small canyons draining into Coal Mine Wash. This habitat supports the greatest number of breeding bird species relative to the other major habitats studied. A number of breeding bird species are restricted to it. It is preferred habitat for the spotted owl. Mammal densities may be correspondingly great as well. The mixed conifer woodland will not be disturbed as a result of mining activities.

The tamarix riparian strand habitat occurs along intermittent reaches of the major ephemeral wash channels. The most extensive stand of tamarix riparian strand occurs along Moenkopi Wash in the southwest section of the study area. Its importance is manifested in

the exploitation by numerous small foliage gleaning and ground feeding passerine bird species that migrate through during the spring and fall. This habitat will not be disturbed as a result of surface mining activities.

The J-7 impoundment, and to a lesser extent other major impoundments, provide important aquatic and shoreline habitat. The J-7 pond is particularly unique because it is the only substantial body of water for many miles that has existed for any length of time. A diverse assemblage of waterfowl and shorebirds, as well as other bird species are attracted to it in migration. It also supports a substantial Centrarchid fish population. Anglers are occasionally observed fishing the pond. The area surrounding the J-7 impoundment will not be disturbed as a result of surface mining activities. However, the pond was constructed to provide emergency water for the coal slurry pipeline. Should water be required for coal transportation, the pond would be impacted.

Cliffs, bluffs, and talus slopes are of limited occurrence in the study area. Where they do occur, they provide shelter for a number of small mammal species, occasional nest sites for red-tailed hawks, great-horned owls, and northern ravens, and a small number of smaller rock inhabiting bird species. The larger cliffs consist of unconsolidated scoria rock outcrops. The smaller bluffs consist of buff-colored sandstone outcrops along larger drainages. Talus slopes may be associated with cliffs or bluffs or may be exposed on hillsides. Localized areas of this habitat feature will be disturbed as a result of surface mining activities. Plans to mitigate the disturbance are included in Volume 11, Chapter 23.

Impact Analysis

Impact analysis is performed on the basis of the findings of the baseline and ongoing monitoring studies performed to quantify fish and wildlife and their habitats on and surrounding the leasehold. Consideration is given to the potential impacting activities as well as possible impact mechanisms. Much of the assessment was included in previous sections in species and habitat specific discussions.

The approximate acreages of each vegetation community that will be disturbed by mining activities on the Black Mesa leasehold were given in Chapter 9. These acreages represent the incremental disturbances of all biotic and abiotic land surface attributes which constitute wildlife habitat.

The loss mining related disturbances will have varied impacts on wildlife populations. The impacts may be direct or indirect. Removal of the vegetation and land form will result in the direct loss of food, cover, and breeding habitat. Noise and related impacts associated with concentrated industrial activities will disturb sensitive wildlife in close proximity to the activities. Disturbance of the land surface and subsurface creates the potential for impacting surface and ground water quality and quantity, and destroys natural physical shelters.

Mobile wildlife species will not be as severely influenced by the disturbances as less mobile small mammals, strongly territorial birds, reptiles and amphibians. The restricted species can be expected to be extirpated in the disturbance areas. The larger and more mobile species will be displaced into surrounding areas, temporarily creating increased competition for the available resources. If the surrounding areas are at or near carrying capacity, populations will be stressed until a new equilibrium is reached. Displaced species which have the capacity to exploit the habitat created by reclamation activities will repopulate developing reclaimed areas.

Overall, the fauna in the lease area must be described as sparse; apparently attributable to habitat quality and condition. The areas that will be disturbed exhibit less value to wildlife in their present state than what would be expected under more pristine conditions. There are extensive tracts of these habitats throughout the southwest, and since few, if any, vertebrates are wholly dependent upon them, the impact of manipulation of a small percentage can be viewed as negligible.

The majority of the important wildlife species, habitats and habitat features identified in previous sections will not be significantly impacted by mining activities. Cases where impacts are expected or additional baseline information is required, have been identified. The Revegetation Plan (Chapter 23) presents measures to mitigate the impacts identified. Much of the mitigation involves habitat enhancement activities in the postmining landscape such as: 1) tree and shrub planting; 2) rock and brush pile installation; 3) riparian vegetation establishment around internally draining ponds; 4) installation of raptor perch sites; 5) interspersion of shrub and tree clusters; and 6) topographic manipulation (drainage reestablishment). These activities are designed in accordance with the land use decisions and priorities that have occurred on the pre-mining lands and their relationship to the intended postmining land use.

Wildlife Resources Protection

The information obtained from the baseline and ongoing monitoring studies is used by Peabody to identify potential impacts to fish and wildlife resources. In turn, procedures for minimizing or preventing impacts, and measures for enhancing wildlife resources and mitigating habitat loss are developed. Direct and indirect measures for protecting wildlife resources are incorporated throughout the Mining and Reclamation Plan. They include:

1. Procedures for identifying, reducing and preventing air, and surface or ground water contamination (see Volume 8, Chapter 12, Page 2; Volume 11, Chapter 17, Pages 1-5);
2. Procedures for minimizing vegetation and soil loss or modification (see Volume 11, Chapter 22, Pages 48-49; Volume 11, Chapter 23, Pages 12-16);
3. Prevention of solid waste contamination (see Appendix C);
4. Compliance with MSHA guidelines for noise reduction discussed in Volume 1, Chapter 3;
5. No prescribed burning plans and spoil fire precautions and control (see Volume 11, Chapter 21, Page 2);
6. Installation of power transmission facilities in accordance with "Suggested Practices for Raptor Protection on Power Lines. The State of the Art in 1981", developed by the Raptor Research Foundation, Inc., Department of Veterinary Biology, Univ. of Minnesota, St. Paul, 55101.
7. No use of persistent pesticides in the mining or reclamation process;
8. Monitoring of water quality in selected ponds used by livestock and wildlife as a water source, with provisions to exclude use should toxicity problems be indicated (see Volume 11, Chapter 16, Pages 28-36);
9. Minimizing mining and related disturbances.
10. Annual monitoring for raptor nest sites ahead of and adjacent to mining disturbances in each coal resource area with provisions to notify and consult with the OSMRE regarding nest status, species, and guidance for mitigation measures.
11. Monitoring plans for the Black-Footed Ferret and Peregrine Falcon (see Attachment 2), and Mexican spotted owl (see text).
12. Prompt reporting to the OSMRE of any State or Federally-listed endangered or threatened species within the permit area of which the operator becomes aware pursuant to 30 CFR 816.97(b).

The levels of intensity of the protection measures are designed in accordance with the following facts concerning the wildlife resources on the leasehold:

1. No wildlife migration routes occur on the leasehold;
2. Of the high value habitats or habitat features identified in baseline studies, the mixed conifer woodland and tamarix riparian strand will not require special protection because they will not be disturbed. The J-7 impoundment could potentially be used as an emergency water supply for the coal slurry line at Black Mesa Mine. Localized areas of cliffs, bluffs, and talus slopes will be disturbed, but will be mitigated by the installation of rock/brush piles in reclaimed habitats (see Chapter 23);
3. The habitats on the leasehold (with the exception of a small amount of mixed conifer woodland) cannot be considered critical to the continued existence of any Federal, State, or Tribal listed threatened or endangered wildlife;
4. No naturally occurring wetlands occur on the leasehold;
5. The majority of wildlife species of high Federal interest are uncommon transients.
6. With the possible exception of the Mexican spotted owl, suitable resources do not exist on or in close proximity to the Peabody lease area to support residence (breeding populations) by any listed endangered or threatened wildlife;
7. Construction and enhancement of aquatic areas benefits wildlife that visit the leases when in migration;
8. The wildlife habitats which occur naturally on the leasehold are in poor condition due to livestock related impacts.

Baseline studies and ongoing reconnaissance for raptors and raptor nest sites has revealed that the leasehold and surrounding region supports fairly abundant populations of raptors, especially red-tailed hawks. The occurrence of 22 raptor species has been documented on the leasehold. The majority have been identified as non-breeding transients or winter residents. Table 16 identifies the six species that are confirmed breeders and nine additional species that may breed.

Annual nesting surveys have been conducted throughout the leasehold since 1982. To further quantify mining impacts on nesting raptors, the annual surveys will be concentrated on areas immediately in advance of and within 0.25 miles adjacent to each active mining area. Surveys will target all confirmed or probable breeding species (see

Table 16) of high Federal interest. The nesting surveys will be conducted during an extended 22-week period from approximately March 15 to August 15. Surveying during this extensive period is necessary because of the overlapping of nesting chronologies of the species involved. Fledgling raptors can be conspicuous on or near nesting territories in the final four weeks of the survey period, thereby revealing nesting where no evidence of such had been previously noted. Standard survey methods (Call 1978; Craighead and Craighead 1956; Rosenfield et al. 1985), previous monitoring data, and interviews with local residents will be used to conduct the surveys. Methods will include the use of species-specific cassette tape calls used at night for owls and during the early morning hours for accipiters from pre-established vehicular or walking routes distributed throughout each survey area. Alarm or territorial responses will be noted for each species and plotted on maps to delineate territories and pinpoint nest locations. Methods will also include direct observation using binoculars and spotting scopes from selected vantage points. Vantage points will be selected to insure complete and overlapping line of sight coverage of the study area. Attention will be given to observing breeding behavior such as courtship displays, nest-building activities, calling and/or begging, etc. Raptors that are sighted will be continuously followed until nest locations are revealed. The concentrated surveys will be initiated in the spring of 1989. Initially, the surveys will be conducted in the 1988, 1989, and 1990 projected disturbance areas to establish a time differential between the active pit areas and survey areas. This will insure that adequate lead times are established should nests be located which will require impact mitigation. The surveys will be continued on an annual basis in each successive projected annual disturbance block that is at least two years ahead of active mining (e.g., 1991 mining blocks will be initially surveyed in 1989). Areas to be impacted will also be surveyed a year ahead, and in the spring of the same year of mining disturbance to identify any new nests in the area.

The OSMRE will be notified of any active nests found to be in the path of the mining disturbance. Peabody will cooperate with the OSMRE to determine the proper course of action to be taken should such a nest be identified.

A change in the mining schedule at the N-11 mining area necessitates conducting site-specific raptor nest surveys starting the same year as mining disturbances. At N-11, the raptor surveys will be started in 1994 as early in the breeding season as possible to ensure that raptor nest sites are identified prior to initial mining-related disturbances. Sediment pond construction and topsoil removal are scheduled to begin in the spring.

Overburden stripping is scheduled to begin as early as late summer.

The N-11 survey plan will incorporate the methods previously outlined for surveys ahead of active pits (i.e., call stations and direct observation). However, call station density and calling frequency will be intensified. In addition, intensive ground surveys of all suitable nesting habitat and likely nesting situations will be conducted in areas where initial mining disturbances are planned. Searches for nests will be concentrated in these areas utilizing qualified biologists to identify specific nest sites (i.e., tree-to-tree searches in suitable habitat and nesting situations). After the specific searches have been completed, general reconnaissance, call stations, and direct observation will be used to survey the broader areas scheduled for disturbance later in the year. The OSMRE will be immediately informed of any nest sites that are discovered.

The N-11 raptor survey plan will also incorporate nocturnal surveys for Mexican spotted owls. Nocturnal surveys, following the U.S. Forest Service survey protocol, will be conducted in the mixed conifer woodland habitat situated closest to disturbance activities at the N-11 mining area (approximately 1.5 miles distant). A minimum of two survey stations will be used to cover the habitat areas located closest to mining disturbances. The two initial survey stations will be located at approximately 1,400N by 46,200E and 5,400N by 44,400E (PWCC coordinate system). If Mexican spotted owls are detected during these surveys, additional survey points will be established in consultation with the OSMRE, and follow-up survey work will be initiated to identify roosting or nesting sites. The OSMRE will be immediately notified if any Mexican spotted owls are detected during the survey effort.

Peabody's Mining and Reclamation Plans have stressed the importance of an effective revegetation plan to minimize the impacts to wildlife from the land surface disturbances. The plans are designed to optimize revegetation for the postmining land uses of livestock grazing and wildlife habitat (refer to Chapter 14 for a complete discussion of Land Use). The species selected for revegetation will provide high utility as cover and food for those species capable of utilizing the grassland, shrubland, and shrub and tree corridors that are provided (see "Species Selection and Justification", Chapter 23). The permanent vegetation provides for the stabilization of soil resources, improved water availability and a diverse and stable cover. The Revegetation Plan (Chapter 23) includes wildlife habitat enhancement measures designed to improve wildlife habitat in the postmining

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landscape (see "Seeding and Planting Arrangements" and "Additional Wildlife Habitat Considerations", Chapter 23). These enhancement procedures and the protection measures previously discussed are designed to help mitigate the unavoidable impacts previously discussed.

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ATTACHMENT 1

REFERENCE LISTING FOR STUDIES AND INFORMATION RELEVANT TO FISH AND WILDLIFE RESOURCES ON OR NEAR THE BLACK MESA LEASEHOLD

REFERENCE LISTING FOR STUDIES AND INFORMATION RELEVANT TO

FISH AND WILDLIFE RESOURCES ON OR NEAR THE BLACK MESA LEASEHOLD

DOCUMENT	DOCUMENT DESCRIPTION	SUBJECT	REFERENCE
1981-1985 Mining and Reclamation Plan (MRP) (Submitted June 6, 1981)	Mining Permit Application for J-7, J-1/N-6, N-7/8 and N-14 Areas	- Terrestrial Vertebrate Sampling Methods	Vol. 3, p. 3-3
		- Habitat Descriptions	Vol. 3, p. 3-8
		- Terrestrial Vertebrate Sampling Results and Discussion	Vol. 3, p. 3-17
		- Recreationally or Commercially Important Species	Vol. 3, p. 3-65
		- Rare, Threatened or Endangered Species	Vol. 3, p. 3-66
		- Raptors and Key Migratory Species	Vol. 3, p. 3-70
		- Other Important Species	Vol. 3, p. 3-70
		- Significance of Local Wildlife	Vol. 3, p. 3-72
		- Aquatic Communities	Vol. 3, p. 4-1
		- Ecologically Sensitive Areas	Vol. 3, p. 5-1
		- Impact Assessment	Vol. 3, p. 6-1
		- Mitigation	Vol. 3, p. 7-1
1981-1985 MRP; Supplement 1 (submitted Feb. 13, 1981)		- Large Mammal Overpasses	Vol. 13, p. 4

REFERENCE LISTING FOR STUDIES AND INFORMATION RELEVANT TO
FISH AND WILDLIFE RESOURCES ON OR NEAR THE BLACK MESA LEASEHOLD (Cont.)

DOCUMENT	DOCUMENT DESCRIPTION	SUBJECT	REFERENCE
		- Large Mammals on Black Mesa	Vol. 13, Tab A
		- Design of Wildlife Passageways (Overland Conveyor)	Vol. 13, Tab B
1981-1985 MRP (Submitted June 8, 1981)	Apparent Completeness Review Response	- Raptor Nest Discussions	Vol. 17, Tab E
		- Threatened or Endangered Wildlife	Vol. 17, Tab E
1981-1985 Mine Plan Modification (MPM submitted Feb. 13, 1985)	Mining Permit Application for J-19, J-20, J-21 Areas	- Terrestrial Vertebrate Sampling Methods	Vol. 44, Appendix I, p. 44
		- Habitat Descriptions	Vol. 44, Appendix I, p. 45
		- Terrestrial Vertebrate Sampling Results and Discussion	Vol. 44, Appendix I, p. 47
		- Aquatic Areas	Vol. 44, Appendix I, p. 89
		- Important Species	Vol. 44, Appendix I, p. 90
		- Significance of the Vegetation and Wildlife Resources	Vol. 44, Appendix I, p. 98
		- Impact Analysis	Vol. 44, Appendix I, p. 103
		- Mitigation, Enhancement, Monitoring	Vol. Appe , p. 104

REFERENCE LISTING FOR STUDIES AND INFORMATION RELEVANT TO

FISH AND WILDLIFE RESOURCES ON OR NEAR THE BLACK MESA LEASEHOLD (Cont.)

DOCUMENT	DOCUMENT DESCRIPTION	SUBJECT	REFERENCE
1981-1985 MPM (submitted Jan. 19, 1984)	Apparent Completeness Review Response	- Raptor Nest Survey Discussion	Vol. 46, Tab 16
Arizona Division, P.C.C., 1982	Vegetation and Wildlife Resources 1981 Report for the Black Mesa Leasehold (Baseline Data for J-16/28 Areas)	- Terrestrial Wildlife Sampling Methods	p. 64
		- Results and Discussion	p. 65
		- Impact Analysis	p. 81
Arizona Division, P.C.C., 1984	Vegetation and Wildlife Resources Report for the Black Mesa Leasehold (leasewide monitoring)	- Migratory Waterfowl and Shorebird Study Methods	p. 29
		- Results and Discussion of Migratory Waterfowl and Shorebird Studies	p. 30
		- Migratory Waterfowl and Shorebird Data Summary Reports	Appendix B
Arizona Division, P.C.C., 1985	Vegetation and Wildlife Resources 1984 Report for the Black Mesa Leasehold (leasewide monitoring)	- Raptor Studies	p. 52
		- Non-game Bird Studies	p. 71
		- Mitigation and Enhancement Discussion	p. 84

REFERENCE LISTING FOR STUDIES AND INFORMATION RELEVANT TO

FISH AND WILDLIFE RESOURCES ON OR NEAR THE BLACK MESA LEASEHOLD (Cont.)

DOCUMENT	DOCUMENT DESCRIPTION	SUBJECT	REFERENCE
Western Division, P.C.C., 1986	Vegetation and Wildlife Resurces 1985 Report for the Black Mesa Leasehold (leasewide monitoring)	- Wildlife Habitat Enhancement Activities (N-2, 12 Pond)	p. 8
		- Commercial Furbearer Trapping Discussion	p. 62
		- Small Mammal Studies	p. 66
		- Breeding Bird Censuses	p. 67
		- Raptor Nesting Survey	p. 70
		- Special Interest Wildlife Sightings	p. 72

ATTACHMENT 2

Peregrine Falcon and Black-footed Ferret

Monitoring Plan for the Black Mesa and Kayenta Mines

Introduction

Pursuant to requirements in the Endangered Species Act of 1973 as amended (50 CFR 402.12), the Office of Surface Mining Reclamation and Enforcement (OSMRE) has prepared a biological assessment for the Black Mesa and Kayenta Mines. The impacts of the mining and reclamation plans proposed by Peabody on three threatened and endangered species were evaluated by OSMRE in the biological assessment. These species included the humpback chub (Gila cypha), peregrine falcon (Falco peregrinus), and black-footed ferret (Mustela nigripes).

The OSMRE, working in consultation with the Arizona Game and Fish Department (AGFD), the Navajo Nation Department of Fish and Wildlife (NNDFWL), the Bureau of Indian Affairs (BIA), and the U.S. Fish and Wildlife Service (USFWS), identified certain inadequacies in Peabody's proposed wildlife protection plans with regard to the black-footed ferret and peregrine falcon. OSMRE required Peabody to develop monitoring plans to insure protection of these species. The remainder of this document outlines the monitoring plans for the black-footed ferret and peregrine falcon. These plans were developed in recognition of the concerns identified in the biological assessment and subsequent correspondence between all parties involved with these issues. Monitoring of prairie dog colonies related to black-footed ferret survey requirements will continue on an annual basis at this time. Peregrine falcon survey work has been completed.

Black-Footed Ferret

The results of prairie dog and black-footed ferret surveys conducted by Peabody on the Black Mesa leasehold since initiating baseline wildlife studies in 1979 were summarized in the biological assessment. These and subsequent surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of black-footed ferrets, and documented the decline of prairie dog populations over the past twenty years. To date, the number, extent, and distribution of prairie dog colonies on the leasehold has failed to meet the currently accepted USFWS minimum requirements necessary to justify black-footed ferret searches (USFWS 1986). The prairie dog colonies on the Black Mesa leasehold have been too small and widely distributed to support black-footed ferrets. However, the potential for reexpansion of existing prairie dog colonies and/or establishment of new colonies exists, and

was identified in the biological assessment. If a significant reexpansion of the prairie dog colonies should occur such that a population of ferrets could be supported, then ferret searches would be warranted. Therefore, the following black-footed ferret monitoring plan has been implemented.

A survey of the prairie dog colonies that occur on and within one-half mile of the permit area will be conducted on an annual basis. This survey will consist of delineating prairie dog colonies within the study boundary. Colonies will be located using aerial imagery and ground truthing. A routine check for ferret sign (i.e., diggings, scats, etc.) will be conducted during examination of the prairie dog colonies. Any colony not active for three or more years will not be monitored during annual wildlife monitoring activities. The general reconnaissance for special interest species will continue to be conducted during annual monitoring and should identify any new or reactivated colonies in the future.

Following delineation and quantification of prairie dog colonies in the study area, an evaluation will be made regarding the need for black-footed ferret surveys. If either a unit or association of prairie dog colonies is determined to meet or exceed the minimum acreage requirements for performing ferret surveys, then surveys will be conducted in accordance with the Black-Footed Ferret Guidelines for the Navajo Nation (NNDFWL, June 20, 1985).

The results of the prairie dog surveys conducted in the study area will be presented to the regulatory authorities on an annual basis. If the minimum ferret survey requirements are met, the regulatory authorities will be notified immediately after the prairie dog colony evaluation is completed so that a coordinated plan to conduct the ferret surveys can be formulated. Should ferrets be discovered, the regulatory authorities will be notified immediately. In addition, Peabody will incorporate NNDFWL approved revisions to the current guidelines as such revisions occur.

Peregrine Falcon

Potential mining related impacts to the peregrine falcon were identified in the biological assessment. In order to insure protection of the peregrine falcon, OSMRE requested Peabody to develop monitoring plans to identify the occurrence or extent of any impacts and to quantify breeding activities in the historic eyrie habitat located north and east of the permit area. The methods used to conduct these surveys are discussed in the following sections on Nesting Surveys and Breeding Surveys.

At this time, mining related disturbances within the three mile buffer area have essentially been completed. Only a small amount of final reclamation in N-14 remains to be completed as of November 2001 and any current or planned mining activity will be further removed from this area and the potentially suitable habitat identified prior to initiation of nesting surveys.

Peabody/PWCC has conducted nesting surveys as detailed in the peregrine falcon monitoring plan periodically from 1989 through 2000. The results have been reported in the annual wildlife monitoring reports submitted to OSMRE from 1989 to 2000. Nesting peregrine falcons have been documented during this period. Peabody/PWCC conducted the peregrine falcon breeding surveys as outlined in the monitoring plan from 1991 to 1995. The results of these surveys were provided confidentially to NNDFWL with OSMRE notification by transmittal letter. The peregrine falcon breeding survey work was completed in 1995 (see OSMRE letter and accompanying Technical Evaluation Report to PWCC dated May 29, 1997). The peregrine falcon monitoring program conducted by Peabody/PWCC contributed to the status of knowledge necessary to determine the peregrine falcon recovery level in the southwest. The success of the recovery program resulted in the peregrine falcon being removed from the USFWS T&E list in August 1999. The peregrine falcon was down listed to G4 status by the NNDFWL in 2001.

Based on the current mining and operations plans for the Black Mesa Complex, the completion of monitoring requirements, and the delisting of the peregrine falcon, further monitoring for this species will be suspended at this time. If future mining activities or species status changes dictate the need for future monitoring, the following nesting survey discussion or any necessary modification, will be initiated as the monitoring plan following consultation with OSMRE, USFWS and NNDFWL. The breeding survey plan is included for historical reference but will not be included in any future monitoring effort.

Nesting Survey Within Three Miles of Mining Operations. The OSMRE indicated in the biological assessment that mining activities, particularly blasting, was a potential direct impact on peregrine falcons nesting within three miles of mining activities. Accordingly, the nesting survey was required within areas of concern.

Peabody completed an assessment of the existence and suitability of nesting cliffs within a three mile buffer of disturbance area boundaries. A model developed by Ellis (1982) was used to evaluate the suitability of potential nesting habitat. Only limited reaches of cliffs in the Moenkopi Wash drainage northeast of the N-14 mining area were identified as possible

nesting habitat using a rather liberal interpretation of the habitat evaluation criteria in the Ellis model. Peabody identified five locations where the presence/absence of nesting peregrine falcons could be determined through vantage point surveillance of the acceptable cliff faces. The cliff reaches surveyed represent the entire potentially suitable habitat located within the three mile buffer area.

The nesting survey was initiated during the first half of April, 1989. Sampling earlier than this is unwarranted since peregrines just begin arriving in northern Arizona in late March (oral) communications: D. Ellis, USFWS; R. Clinski, AGFD; P. Ryan, NNDFWL; and LaRue, Peabody Coal Company, personal observations). Each of seven potential areas were ground-truthed to provide final verification of habitat suitability. Two of the seven areas were found to be unsuitable based upon the lack of prominent or extensive cliff formations. No surveillance was conducted in these areas. The remaining five areas were surveyed in accordance with the AGFD Survey Protocol for Breeding Peregrine Falcons, except that surveys were made from surveillance points that were occupied for a three to four hour period in the morning. Mid-day watches were conducted as time permitted. Binoculars and spotting scopes were utilized to document peregrine falcon activity. No peregrine falcon breeding activities or nest sites were observed in 1989. The complete results of the initial survey were reported in the 1989 Annual Wildlife Resources Report.

The peregrine nesting survey, initiated in 1989, was continued periodically through 2000. Successive surveys were to be conducted every five years, but the actual frequency was somewhat greater. The five-year interval was to correspond to the culmination of each five-year permit term, and was to be continued until mining related disturbances were completed within the three-mile buffer area. Mining related disturbances (N-14) have essentially been completed in this buffer area. When nesting was documented, the nests were monitored to determine number of young and number fledged. During the interim between nesting surveys, Peabody/PWCC has continued its routine surveillance for raptors. If the frequency of peregrine falcon observations on the leasehold changed, which might indicate increased number of nesting pairs adjoining the leasehold, the OSMRE was to be notified and the frequency of nest surveys increased. PWCC will incorporate approved revisions to the AGFD survey protocol into the monitoring plans as such revisions occur.

Breeding Survey Within the Historic Eyrie Habitat. Historic and potential peregrine falcon nesting habitat has been identified to the north and east of the proposed life-of-mine permit area along the Black Mesa escarpment. The escarpment contains "superior" habitat according

to the categories defined by Ellis (1982), although little was known about the current breeding status of peregrines in the area at the time. The OSMRE determined that mining and associated disturbances are sufficiently distant to preclude direct impacts on peregrines nesting along the escarpment.

The data required to assess the peregrine falcon recovery in the southwest at the time remained lacking, particularly in northern Arizona. The OSMRE recognized that the Black Mesa escarpment may be of significant importance in assessing the status of peregrines in the northern part of the state. Further, additional information regarding the breeding status of the peregrine on the Navajo Reservation could be utilized by the Tribe to assess developmental projects which could impact breeding populations. Consequently, OSMRE recommended that Peabody conduct breeding surveys in portions of the historic nesting habitat as a conservation measure to contribute to the peregrine protection and recovery effort. Accordingly, Peabody/PWCC conducted breeding surveys within the historic area from 1991 to 1995.

The breeding survey was conducted in an approximately 40-mile section of the Black Mesa escarpment extending from Lolomai Point east and south to Mesa Trail Wash, and from Yale Point south to Lohali Point as per an agreement between Peabody and the NNDFWL. The time period for making the surveys was from March through June on an annual basis for five years beginning in 1991. The surveys were conducted in accordance with the Survey Protocol for Breeding Peregrine Falcons developed by the AGFD. The survey, including monitoring of known sites, included the collection of data pertaining to territory occupancy and productivity.

The data was reported to the NNDFWL to the attention of the Management/Research Section Supervisor. The OSMRE received a copy of the cover letter transmitting the data reports. The peregrine data has been maintained with other sensitive raptor data that the NNDFWL has been collecting. These data have been kept confidential and secure and were not provided to the general public. Only breeding pair density and productivity data was sent to the AGFD to assist in their assessment of recovery.

Nest site locations were presented in terms of number per logical increments of habitat in the survey area based upon the linear extent of surveyable cliff faces and intercepting side canyons (approximately 3-7 mile reaches), as per agreement with the NNDFWL. Should specific developmental project conflicts arise in the area of concern, Peabody would cooperate fully with responsible personnel within the NNDFWL and the Navajo Natural Heritage Program to

disclose the exact locations of nests that could potentially be impacted by a development project. Productivity data, including fledgling success was collected at as many nest sites as possible (a minimum of three, should that many nests be located), during each year of the survey.

Off-Lease Access

Both the black-footed ferret and peregrine falcon monitoring plans require that PWCC survey outside of the current boundaries of the Black Mesa leasehold. Rights of access off the leasehold must be granted by the Navajo Tribe. Past experience has shown that rights of access granted by the Tribe are contingent upon obtaining agreement from the local residents on whose customary use area access will be needed. Occasionally, local residents will lock gates in an attempt to control livestock pasturage or discourage unwanted traffic in more remote areas. If PWCC should encounter access problems during future monitoring, the survey effort will be discontinued until the situation can be resolved. PWCC will contact the NNDFWL and OSMRE if problems arise. PWCC will make every effort to comply with the terms of access agreements needed to perform these studies and the desires of the affected local residents. However, under no circumstances will PWCC be held responsible for failure to complete the monitoring plans as proposed if access cannot be obtained or maintained during critical survey periods.

Literature Cited

Ellis, David H. 1982. The peregrine falcon in Arizona: Habitat utilization and management recommendations. Institute for Raptor Studies Research Report No. 1. The Institute for Raptor Studies, Box 4420, OM Star Route, Oracle, Arizona 85623. 74 pp

U.S. Fish and Wildlife Service (USFWS). 1986. Black-footed ferret survey guidelines for compliance with the Endangered Species Act. USFWS, Denver, Colorado and Albuquerque, New Mexico 13 pp.

ATTACHMENT 3

VIBRA-TECH
The Vibration Monitoring Experts
4955 Miller Street, Suite 201, Wheat Ridge, CO 80033
303-940-8884 FAX 303-940-8885

December 12, 1994

Mr. Brian Dunfee
Senior Manager
Environmental Engineering
Peabody Coal Company
1300 South Yale
Flagstaff, AZ 80601

RE: Air overpressure attenuation in the N-10 area.

Dear Mr. Dunfee,

Vibra-Tech Engineers, Inc. has been asked to comment on attenuation of air overpressure generated by blasting operations from the N-10 pit at Kayenta Mine, Arizona. Relatively few blasts have been monitored in this area as it is a pit that is not yet in production.

Air overpressure, or air blast, from an explosion is a compressional wave in the air. It is produced by either the direct action of the explosive products from an unconfined explosion on the air or the indirect action of a confined material subjected to an explosion. Air overpressure is measured in units of dBL, a logarithmic scale with a flat response that includes audible (20-20,000 Hertz) and concussion (2-20 Hertz) ranges.

Factors that greatly influence air overpressure are; degree of explosive confinement, distance between source and receiver, charge weight. Less influential factors include; wind speed and direction, temperature, topographical features. In the case of mining the object is to confine the explosives in order to maximize rock fragmentation. Unconfined explosions do not produce the desired results and are costly. Distance between the closest approach of blasting to a known nesting site is a minimum of 7392 feet (Table 30, Chapter 10, Volume 8). This distance from the closest potential blasting to a nesting site is the single factor that most significantly effects the reduction of the air overpressure. Wind speed and direction and temperature are beyond operator control. The topographical features of the area are quite rugged adding to the reduction of potential air overpressure at the stated locations. The nesting locations are up side canyons from the principal drainage's, Coal Mine Wash and Yellow Water Canyon

Wash. All of these factors contribute to the limited potential magnitude of the air overpressure.

The worst case scenario for air overpressure impact on the nesting sites would include a temperature inversion and high winds in the direction of the nesting locations. In this circumstance the topography would significantly mitigate the potential air overpressure impact. The nesting locations are well protected in steep side canyons. Air overpressure energy, which diminishes with increasing distance, will tend to stay in a wash and not turn up side canyons.

The highest air overpressure measured in the N-10 area was 136 dBL measured at a distance of 2000 feet. The shot is an example of a "worst case scenario" as it is far from typical. Using the air overpressure attenuation equations given in "Dupont Blasters Handbook" page 435 this worst case blast equates to air overpressure at the 7392' distance of 122.4 dBL. This estimate of peak air overpressure is based on the highest air blast measurement at Kayenta Mine. It does not project additional mitigating factors such as topography.

It is important to note that in the 7+ months of air overpressure monitoring at Kayenta Mine the highest air overpressures have come from wind gusts. Blasting is a relatively transient event that lasts for a few seconds 3 to 10 times per week. Relative to the wind gusts in the region these blast events are anomalous air pressure changes. The regulatory limit of 133 dBL is approximately equivalent to a wind speed of 19 miles per hour.

Sincerely,

Colin M. Matheson
Area Manager
Vibra-Tech Engineers, Inc.

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Raptor Responses to Low-level Jet Aircraft and Sonic Booms

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&

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ABSTRACT

*We estimated effects of low-level military jet aircraft and mid- to high-altitude sonic booms (actual and simulated) on nesting peregrine falcons (*Falco peregrinus*) and seven other raptors by observing their responses to test stimuli, determining nesting success for the test year, and evaluating site reoccupancy rates for the year following the tests. Frequent and nearby jet aircraft passes: (1) sometimes noticeably alarmed birds, (2) occasionally caused birds to fly from perches or eyries, (3) most often evoked only minimal responses, and (4) were never associated with reproductive failure. Similarly, responses to real and simulated mid- to high-altitude sonic booms were often minimal and never appeared productivity limiting. Eighteen (95%) of 19 nest sites subjected to low-level jet flights and/or simulated sonic booms in 1980 fledged young during that year. Eighteen (95%) of 19 sites disturbed in 1980 were reoccupied by pairs or lone birds of the same species in 1981.*

*We subjected four pairs of prairie falcons (*Falco mexicanus*) to low-level aircraft at* ad libitum *levels during the courtship and incubation phases when adults were most likely to abandon: all four eyries fledged young. From heart rate (HR) data taken via a telemetering egg at another prairie falcon eyrie,*

we determined that stimulus-induced HR alterations were comparable to rate changes for birds settling to incubate following flight.

While encouraging, our findings cannot be taken as conclusive evidence that jet flights and/or sonic booms will have no long-term negative effects for other raptor species or for other areas. In addition, we did not experiment with totally naive wild adults, rotary-winged aircraft, or low-level sonic booms.

INTRODUCTION

The potential detrimental effects of sonic booms and other loud noises on wildlife have been reviewed by the National Academy of Sciences (1970), Bond (1971), Cottereau (1972), Rylander (1972), Slutsky (1975), Ewbank (1977), Fletcher and Busnel (1978), and Jehl and Cooper (1980). Loud noises have been associated with changes in heart rate (HR), increased irritability, and altered rates of maintenance behavior in some laboratory animals (Environmental Protection Agency, 1971). Fleeing, flying, and crowding in domestic turkeys and chickens were sometimes observed following loud noise bursts, especially if accompanied by startling visual stimuli (Bell, 1972). Lynch and Speake (1978), however, observed only insignificant short-term responses (30 s or less) in wild turkeys (*Meleagris gallopavo*) responding to simulated sonic booms.

There is circumstantial evidence associating a near-total (99%) hatching failure in sooty terns (*Sterna fuscata*) nesting on the Dry Tortugas Islands with booms produced by supersonic military jets flying at 'deck' level (reviewed in Bell, 1972). High-altitude sonic booms, however, have uniformly failed to cause negative effects on hatching success in laboratory tests (Environmental Protection Agency, 1971; Bell, 1972). Cogger and Zegarra (1980) failed to detect changes in oviposition time, shell weight or thickness, hatchability, or viability in chicken eggs subjected to booms far louder than those expected from high-altitude flights, but not as severe as those associated with the sooty tern hatching failure cited above. Busnel (1978; p. 11) stated, 'While the animal's first reaction to a new noise source... is fear and avoidance, if his other sensory systems (optical, chemical) are not stimulated, the major vertebrates quickly learn to ignore the noise source.'

Schreiber and Schreiber (1980) investigated sonic boom effects on colonial nesting gulls (Laridae) and cormorants (Phalacrocoracidae) and concluded (p. 139), 'we believe that in comparison to a human walking into a bird colony a sonic boom will have minimal effect.' Black *et al.* (1984) reached a similar conclusion regarding low-level flights of military jet aircraft over wading bird colonies in Florida. Breeding success and nestling growth rates

for several species of herons and egrets were independent of jet activity, but closely related to environmental factors.

Some anecdotes are available on raptor responses to aircraft and sonic booms. A few species of raptors (especially territorial adults) occasionally attack slow-flying aircraft (Blokpoel, 1976; Fyfe & Olendorff, 1976; Anon., 1978). Even more remarkable, a northern harrier (*Circus cyaneus*) was observed actively hunting on a US Navy bombing range during practice bombing exercises (Jackson *et al.*, 1977). By contrast, a detailed study showed that ground-based military activities apparently caused an adult male red-tailed hawk (*Buteo jamaicensis*) to avoid portions of its home range during disturbance (Anderson *et al.*, 1986). In subsequent work (Andersen *et al.*, 1990), nesting adults of four species of raptors shifted their activity centers and expanded their home ranges following initiation of military training activities.

Ferruginous hawk (*Buteo regalis*) responses to miscellaneous human disturbances including noises from gasoline-powered engines and a human approaching while firing a 0·22 caliber rifle were studied in southern Idaho (White & Thurow, 1985). Reproductive rates were lower and site abandonment rates were higher for hawks in the treatment group than for controls. By contrast, six pairs of prairie falcons exposed to nearby explosions reproduced normally, and all test eyries were occupied in the year following the experiments (Holthuijen *et al.*, 1990).

Few studies specifically examined the effects of aircraft flights on nesting birds of prey. Platt (1975) subjected gyrfalcon (*Falcon rusticolus*) eyries to 51 helicopter overflights. He found that all birds were disturbed by aircraft at 160 m, none at 600 m, and none when the aircraft were out of sight over the cliff rim. Disturbed birds quickly resumed normal activities, and no pairs were known to have abandoned their eyries due to the helicopter passes. However, none of five sites tested in 1974 were reoccupied in 1975. Red-tailed hawks' productivity following helicopter overflights was similarly uneffected in Colorado (Andersen *et al.*, 1989); however, relatively naive birds exhibited stronger avoidance responses than did hawks nesting in areas of frequent helicopter use.

Another detailed study involved intensive testing of snail kites (*Rostrhamus sociabilis*). N. F. R. Snyder, H. W. Kale II and P. W. Sykes Jr., (1978, unpublished). An evaluation of some potential impacts of the proposed Dade county training jetport on the endangered Everglade kite, Patuxent Wildlife Research Center, Laurel, MD) experimented with a nesting colony in Florida to determine responses to frequent (5–10 min intervals), low-level (152–229 m altitude) aircraft (commercial jet passenger carriers and smaller aircraft). Kites frequently interrupted activities to watch the aircraft for a few seconds, but significant negative responses were not

noted. The study also included observations of four kite colonies near the jetport at Barranquilla, Colombia. Here again, no significant responses were noted. One colony of kites (at least 13 pairs) nested only 420 m from the end of the runway.

The goals of this study were to determine which, if any, of the possible adverse responses listed below were operative in the case of raptors (especially peregrine falcons nesting in Arizona): (1) interruption of parental behavior (leading to exposure of eggs or young to inclement weather), (2) physiological stress of parents or young (leading to reduced reproductive performance), (3) eyrie abandonment (immediate and long-term), (4) accidental death due to premature fledging of startled young, and (5) loss of eggs or small chicks kicked from the eyrie by startled adults (as observed in response to gunshots by Cade, 1960; p. 188).

This report provides an overview of all observed raptor responses to the test stimuli: a more detailed account of each stimulus-response episode is available on microfiche in the document upon which this report is based (Ellis, D. H., unpublished. Responses of raptorial birds to low-level military jets and sonic booms, US Gov. Doc.: NTIS AD-A108 778/2). In interpreting this study, recognize that while some of the wild raptors we observed had little or no prior experience with low-level aircraft and sonic booms, many had experience with both, and all adults likely had at least minimal experience with distant aircraft.

METHODS

We observed behavioral responses for more than 1000 jet aircraft passes and over 100 real or simulated booms for nearly 40 raptor breeding attempts, representing eight species. Our approach was to experiment first with surrogate species, and thereby minimize the possibility of disrupting peregrine falcon breeding efforts. We also hoped to determine if any of these 'surrogate' species were hypersensitive. In many experiments, we attempted to simulate worst-case situations (i.e. booms louder and more often than would be expected, and repeated passes with aircraft more often and nearer than would be expected even in heavily used aircraft flight corridors). The rationale behind this approach was as follows: if severe behavioral responses could not be induced in the worst-case experiments, then we could logically conclude that responses to lighter stimulus loads would be less severe.

To accomplish our objectives, we observed short-term behavioral responses at 31 sites involving seven species and sonic booms (real and simulated) at 31 sites of eight species (Table 1). In assessing long-term behavioral responses, we gathered data on productivity and eyrie

TABLE 1
Two-year Totals for Experimental Flights and Booms at Raptor Sites in Arizona

Year	*Jet aircraft tests*			*Real and simulated sonic booms*		
	Number of species	*Number of sites*[a]	*Number of passes*[b]	*Number of species*	*Number of sites*[a]	*Number of booms*
Tests with wild raptors:						
1980	7	19	239	8	14	22
1981	3	11	686	4	16	87
Tests with two captive austral peregrine falcons (*F. p. cassini*):						
1981	1	1	35	1	1	9
Totals:						
2 years	7	31	960	8	31	118

[a] Almost all sites were breeding locations: one, however, was a ridge where the captive falcons were tested, and two were locations where non-breeding birds were tested. Many sites were tested with both booms and aircraft; therefore, rows cannot be totaled. Because many of the sites tested in 1980 were also tested in 1981, the vertical totals are for site-years not numbers of separate locations.

[b] Included in these totals are observed jet passes that were within 500 m of the bird or eyrie. In 1981, four prairie falcon eyries were targeted for *ad libitum* low-level flights: these flights were not tallied in this Table.

reoccupancy rates for all eight species. Nest success rates in 1980 and 1981 were based on the presence of large nestlings or fledged juveniles. Reoccupancy was indicated by the presence of adults or young in 1981 at eyries tested in 1980.

Because resting HR has been used as an indicator of disturbance and physiological stress in birds (Busch *et al.*, 1978; Siegel, 1980; Harvey *et al.*, 1984), we monitored HR changes in incubating prairie falcons during test situations.

Nest sites studied were from scattered locations, mostly in the southern half of Arizona, and frequently in or near military operations areas (MOA's; i.e. Sells, Tombstone, and Williams MOA's and Fort Luke Air Range).

Stimuli

Early in the study, we learned that jet passes greater than 500 m from the birds consistently failed to elicit significant responses, so all jet passes tabulated here were within 500 m from the birds or nest sites. Six types of aircraft, varying in noise output, were used (Table 2). Although the F-4 is the loudest jet, all aircraft involved in the study are quite loud when nearby. All passes less than 60 m from the cliffs were made by A-10's and A-7's. F-104

TABLE 2
Noise Level Comparisons for Aircraft Involved in the Study

Aircraft type	*Noise levels[a] at selected distances (dB(A) peak values)*			*Number (%) of test passes*
	61 m	*152 m*	*305 m*	
A-4 (Skyhawk)	104	94	86	2 (0)
A-7 (Corsair II)	101	92	85	74 (8)
A-10 (Thunderbolt II)	110	100	92	883 (90)
F-4 (Phantom)	114	105	98	14 (1)
F-15 (Eagle)[b]	97	89	82	0
F-104 (Starfighter)	110	101	94	9 (1)

[a] Sound levels are from Speakman *et al.* (1978) and are for aircraft at normal cruise rpm values rounded to nearest whole dB value. Each 3dB increase equals a doubling of sound energy.
[b] The F-15 is included for comparison. This aircraft was involved in the study only as a source of high-altitude sonic booms.

and A-4 sorties were never requested, so our observations of these aircraft were fortuitous. F-4's were involved only in the first year of the study because they were unable to approach breeding sites closely due to decreased maneuverability at higher flight speeds.

To simulate worst-case situations, we arranged for long series of jet passes at some nest sites during the second year of the study. At one prairie falcon nest site, A-10's passed 18 times in less than 9 mins. The maximum number of passes recorded in a day was 39 for one prairie falcon site. More typically, five to ten passes were made in a test bout; however, at four prairie falcon eyries, A-10 pilots were invited in 1981 to make as many passes as time and fuel allowed.

Three devices (7·6 cm [3 in] mortar salute, 12-gauge shotgun, and propane cannon) were used to simulate sonic booms (Table 3). All three produced impulse noises comparable in peak energy to supersonic jets in the medium- to high-altitude range (2000–3000 m). None generated long duration booms (50–100 ms) normally associated with a jet-induced sonic boom (Maglieri & Henderson, 1973). Aircraft-generated booms were never scheduled and were not measured. The maximum number of booms generated at a test eyrie in one day was 23 at a prairie falcon site.

Because of its small dimensions and mass (*ca.* 200 g), the mortar salute was the most practical boom-generating device to pack to remote locations. Our version of the launching tube, a-25 cm section of 7·6 cm [3 in] diameter PVC plastic pipe capped at one end by a number 303 food storage can, weighed only 120 g. For safety reasons, however, we do not recommend our

TABLE 3
Sound Levels Generated by Boom-stimulating Devices used in the Study[a]

Mortar salute[b]				*Shotgun*[c]				*Propane cannon*[d]			
Distance (m)	n	*Range (dB)*	x̄ *(dB)*	*Distance (m)*	n	*Range (dB)*	x̄ *(dB)*	*Distance (m)*	n	*Range (dB)*	x̄ *(dB)*
30	1		141	30	1		140	13	7	146–151	148
70	1		137	50	1		131				
100	1		134	80	1		130				
				150	1		124	100	5	126–134	129
200	1		139	200	2	114–119	117	150	6	120–126	124
300	1		126					200	6	121–126	124
400	1		125					300	5	116–121	122
600	1		123					400	7	110–116	113
1 100	2	111–116	114					1 100	10	98–103	90

[a] All sound measurements were made with a Gen Rad 1982 Precision Sound Level Meter (settings: WTG, flat peak). Measurements near 140 dB were taken wirh a 10 dB attenuator to avoid exceeding the capacity of the meter.
[b] Three-inch mortar salutes were actually 6·4 cm diameter by 8·7 cm long with a 0·6 m, 2 s fuse. The dB values reported for 30, 70, and 100 m horizontal distance are lower than expected because the explosive detonated after being propelled to *ca.* 110 m aloft. Mortar salute weights are : $\bar{x} = 184$ g, $R = 178$–190 g ($n = 8$).
[c] All shotgun blasts were made using a 12-gauge shotgun with a 76-cm barrel and a 3 3/4-dram game load fired 15–25° away from the bird, or, in this case, the sound meter.
[d] Model M3 Scare Away Gun was supplied by Reed Joseph International Co., Greenville, Mississippi.

lightweight launchers. Three tore apart during the study, endangering field personnel. The recommended launching device, a 9·0 cm [4 in] inside diameter, thick-walled, steel pipe capped at one end by a 5 mm steel plate and buried 0·3 m in compacted earth, however, was impractical for backpacking.

When using a mortar salute, two explosions followed ignition of a fuse. The first, relatively quiet explosion (not tallied here), launched a canister that exploded after about 4 s aloft. Because the canister explosion occurred about 110 m high, it was often visible to the subject birds. In these instances, interpretation of bird responses was somewhat confused. In addition, the launching explosion sometimes resulted in minor grass and clothing fires.

The data gathering sequence

Because we operated on an 'as available' basis with the US Air Force, we had trouble standardizing the experimental situation. In addition, some sorties involved repeated passes with two aircraft. Others consisted of one or a few passes with only a single aircraft. Some eyrie sites allowed for aircraft to approach very close; others were in deep canyons where it was unsafe for an aircraft to come closer than 100 m.

Boom-generating devices also introduced variability. At some eyries, it was possible to conceal the observers and the sound generators. In other situations, the observers and the exploding canister, although 200–400 m from the birds, were visible.

In all but a few instances, tests were made only when the observers were either well-concealed in a nearby blind, or far enough from the birds that the birds indicated by their behavior (i.e. their lack of protest calling and their performance of preening, dozing, or other 'relaxed' activities) that they were not disturbed by the observers. Blinds were typically of plywood construction and had observation glass windows and camera and telescope ports. We used blinds for all nearby observations.

We attempted to standardize the data-gathering sequence. The observer entered the blind or approached a distant observation point at least 30 min before an anticipated flight or boom. He then set up observing and recording equipment including stopwatch, digital watch (displaying seconds), cassette tape recorder, binoculars and/or telescope, UHF radio (if aircraft were expected), notebooks, and boom-generating devices. Data were taken on the tape recorder while periodically announcing time to the nearest second. During many tests, one observer guided the pilots via UHF radio, watched birds aloft to warn pilots of nearby birds when necessary, and estimated bird-to-aircraft distances. The second observer watched stationary birds and dictated an account into a tape recorder. Between experiments, data were transferred to form sheets. For some bouts, important time intervals were measured from the audio tape.

Distances of the aircraft from the eyrie, ground, and flying birds were estimated by: (1) pilots relaying their above-ground-level (agl) readings, (2) extrapolation from the known heights of key topographic features (measured from topographic sheets), and/or (3) comparison with known dimensions of aircraft. Distance estimates for passes very near cliffs and trees were estimated within 10–15 m, and some of these were checked for accuracy by comparison with photographic records. Passes greater than 200 m overhead were generally estimated only to the nearest 50 m and are believed to be accurate within 25%.

Two captive austral peregrine falcons were used to test responses of relatively naive birds. The data gathering sequences for these experiments were much like those for the wild birds except that during the trials the peregrine falcons were either tethered to their perches within 20 m of the observers or one falcon was tethered while the second circled overhead. Some low-level passes were timed to interrupt hunting stoops. For the experiments, the birds were transported to the same elevated ridge where they had been flown daily for the preceding month. After radio contact was established with the approaching aircraft, the female was launched. The aircraft then swept back and forth across the ridge directly over the falcons until the test was complete. For some experiments, three observers were occupied handling the trained falcon, releasing rock doves (*Columba livia*), describing the behavior of the falcons, and communicating with the pilots.

The experimental birds

In 1980, we experimented with eight species of raptors (Table 4). Early in the season, we concentrated our tests on species other than the endangered peregrine falcon. Later in the season, after we had learned the range of responses of other species, we tested several peregrine eyries with a modest number of sorties and booms. In 1981, we concentrated on peregrine and prairie falcons. All phases of the breeding cycle were tested (Figs 1 and 2); however, we concentrated our efforts with the prairie falcon during the courtship and incubation phases when raptors are most likely to desert.

Because pesticide contamination in breeding peregrine falcons may upset homeostasis (Peakall, 1976; Cade *et al.*, 1988) and thereby influence behavior and confound the results of our disturbance tests, we monitored four measures of environmental contaminant levels for this species (Ellis. 1988; Ellis *et al.*, 1989): (1) eggshell thickness, (2) pesticide levels of addled eggs and some shell fragments, (3) pesticide levels in prey species, and (4) overall reproductive performance for test eyries.

Although it was not possible to know exact levels of previous exposure of the test birds to jet passes and sonic booms, it was possible to grossly estimate stimulus loads for test birds on the basis of frequency of booms

TABLE 4

Expected Frequency of Low-level Jets and Sonic Booms at the Study Eyries

Species	*Site*	*Expected frequency of low-level jets*[b]			*Expected frequency of sonic booms*		
		V-inf	*Infreq*	*Freq*	*V-inf*	*Infreq*	*Freq*
Cooper's hawk (*Accipiter cooperii*)	1	+			+		
Common black-hawk (*Buteogallus anthracinus*)	1		+				+
	2	+			+		
	3	+			+		
Harris' hawk (*Parabuteo unicinctus*)	1		+				+
Zone-tailed hawk (*Buteo albonotatus*)	1	+			+		
	2	+			+		
Red-tailed hawk	1		+				+
	2		+				+
	3		+				+
	4		+				+
Golden eagle (*Aquila chrysaetos*)	1			+		+	
Prairie falcon	1			+			+
	4		+				+
	7		+				+
	10		+				+
	11			+			+
	12		+				+
Peregrine falcon	1	+			+		
	2	+			+		
	3	+			+		
	4		+		+		
	5		+		+		
	6	+			+		
	7	+			+		
	8	+			+		
	23	+			+		
	24	+			+		
	25	+			+		
	27	+			+		
	28	+			+		

[a] High-altitude jet activity (3 000 m or greater) can be expected at least infrequently all across Arizona.

[b] Frequencies reported here are approximations of the number of times aircraft normally pass within 500 m of the eyrie. Values are based on our observations of the frequency of 'uninvited' jet activity at the study eyries. The column heading abbreviations are: V-inf (very infrequent) = 1/month; Infreq (infrequent) = 1/week; Freq (frequent) = 1–5/day.

and uninvited aircraft passes during our visits to each eyrie (Table 4). Presumably because supersonic MOA's are in regions of the state offering inferior nesting habitat (Ellis, 1982) for the peregrine falcon, no eyries were known for supersonic MOA's and only two (of 13) peregrine falcon eyries involved in the study were in areas where jet passes could be expected on even an infrequent basis. All prairie falcon eyries were in supersonic MOA's,

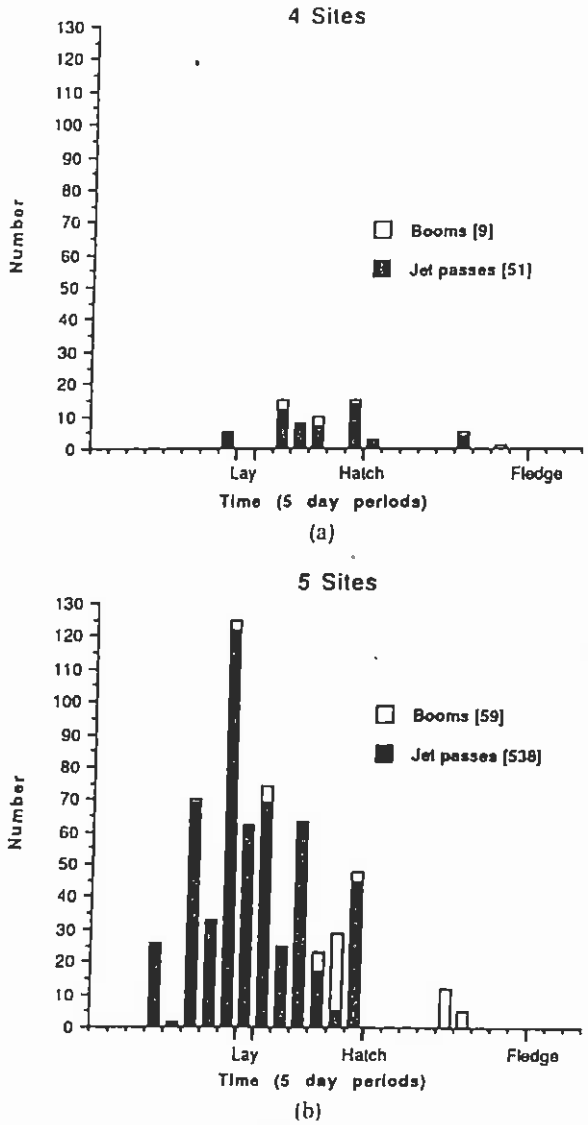


Fig. 1. Timing of stimuli (jet aircraft and simulated sonic booms) at prairie falcon eyries over a 2-year period. Only aircraft passing within 500 m of a bird or eyrie are included. a, stimulus levels for prairie falcons (1980); b, stimulus levels for prairie falcons (1981).

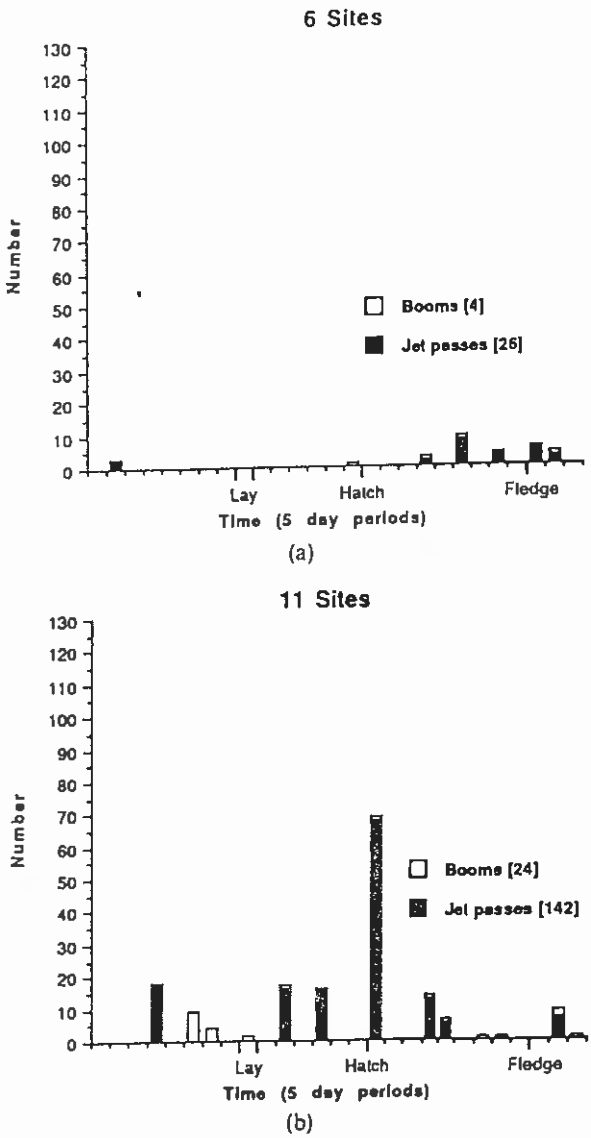


Fig. 2. Timing of stimuli (jet aircraft and simulated sonic booms) at peregrine falcon eyries over a 2-year period. Only aircraft passing within 500 m of a bird or eyrie are included. a, stimulus levels for peregrine falcons (1980); b, stimulus levels for peregrine falcons (1981).

but only two sites could expect frequent nearby jet traffic within 400 m. All red-tailed hawk and prairie falcon eyries were within zones where high-altitude sonic booms were frequent. Most other eyries, including peregrine eyries, were not.

The two austral peregrine falcons used in our jet and boom experiments were taken as nestlings in November 1980 in southern Argentina and trained

to capture rock doves while in free flight. They had minimal previous exposure to low-level aircraft or sonic booms prior to late August 1981 when the birds' reactions to extreme booms and very near aircraft were tested while the falcons were feeding, quietly perching, or, for one bird, in free flight below A-10s.

Heart rate monitoring

At one prairie falcon eyrie in 1981, we used a telemetering egg to monitor disturbance-induced HR changes for incubating falcons. The system (designed by Stuart Enterprises, 3817 Stanford Dr., Oceanside, CA*) consisted of a transmitter, sensitive to very small motions, mounted within an eggshell and a system with elements to receive, process, and record data. The transmitter, powered by a 3 V 600 mAH battery, was embedded in a vinyl–paraffin mixture and encased in sawed-open halves of a bantam chicken eggshell, matching the falcon egg in size. A small hole through the shell allowed access to a screw-driven gain control. The receiving subsystem consisted of a two-element yagi antenna coupled to a sensitive triple-conversion super-heterodyne receiver (Telonics TR-2-148/150†). When the egg was in close physical contact with the incubating adult, the heart beat shook the egg, exciting the accelerometer and causing an RF pulse to be transmitted at 148 MHz. The pulse was detectable by the receiving equipment at up to 1 km. The signal was recorded on a Rustrak recorder and/or counted from the audible receiver signal.

When the incubating falcon was in close contact with one of the telemetering eggs (as evidenced by the presence of a steady HR signal), we tested the falcon's responses to simulated sonic booms and to humans approaching on foot and in a motor vehicle. It proved impractical to have aircraft loitering in the area, waiting for the falcon to readjust to a favorable incubation position, so few HR data were gathered during jet passes.

The HR egg system was calibrated in a great horned owl (*Bubo virginianus*) nest, then colored to resemble a falcon egg before being placed in the prairie falcon eyrie.

Behavioral response categories

We divided short-term behavioral responses into three general categories: insignificant, significant (biologically), and severe (Table 5). Insignificant

* Use of trade names does not signify endorsement by the US Fish and Wildlife Service (FWS).

† Telonics Telemetry, 932 E. Impala Ave., Mesa, AZ 85204-6699. Use of trade names does not signify endorsement by the FWS.

TABLE 5
Short-term Response Alternatives to Disruptive Stimuli[a]

Degree of disturbance →	*Behavioral response alternatives*		
	Insignificant	*Significant*	*Severe*
Adults			
	Stimulus ↓ Alarms, Alerts, Interrupts low priority behaviour	Interrupts high priority behavior, Protest calls, Cowers, Flies Out	
Pre-stimulus behaviour —	Ignores		Panic exit (from eyrie)[b], Delays return, Abandons site
Nestlings			
	Stimulus ↓ Alarms, Alerts, Interrupts low priority behaviour	Interrupts high priority behaviour, Protest calls, Cowers, Flees (on nest)	
Pre-stimulus behavior —	Ignores		Fledges prematurely

[a] Definitions of behavioral responses:
Alerted: feathers sleeked for less than 10 s, if at all, bird interrupts other activities briefly and watches stimulus source.
Alarmed: feathers sleeked, bird intently looks at stimulus source or looks about rapidly turning head in search of stimulus.
Cower: bird crouches (flight intention movements evident) and remains still for at least a brief moment or more often longer.
Protest call: bird protests vocally using same call given at approach of avian predator.
Flies out: difficult to interpret, the bird may either circle out to gain a better view of stimulus situation or to prepare to flee.
Flee: nestlings run to sheltered portion of breeding structure: adults fly out and directly away from stimulus.
Delayed return, Abandonment and Fledges Prematurely: self evident.
[b] Eggs or tiny young may be dislodged by an adult fleeing in panic. Because of this possibility, the bolting of an adult from the eyrie containing eggs or small nestlings is classified as a severe (i.e., progeny endangering) response.

disturbances curtailed low priority behavior (e.g. a preening bout), but not high priority activities. A significant response was tallied when a raptor interrupted high priority behavior (e.g. incubation), but responded as for a routine (i.e. normally encountered) natural disturbance (e.g. a large predator 100 m from the eyrie). The response was judged to be severe if the behavior threatened the success of the reproductive effort (e.g. if an incubating adult bolted from the eyrie, it would endanger eggs or small nestlings).

Delayed or long-term responses to disruptive stimuli (i.e. those resulting in failure to breed, eyrie failure, and site abandonment) are very difficult to link, with certainty, to a causative factor. In a gross effort to study long-term trends, however, we visited test eyries late in the season to determine the number of young fledged, and in 1981, we briefly visited all eyries tested in 1980 to determine if the site was occupied by the same species. No effort was made to determine if individual adults were the same as those tested in 1980.

RESULTS AND DISCUSSION

Long-term effects: productivity and reoccupancy of nest sites

Of 38 nest sites of eight different raptor species subjected to low-level jet flights and/or simulated sonic booms, young successfully fledged from 34 (89%) (Tables 6 and 7). When the 22 sites tested in 1980 were revisited in 1981, pairs or lone birds of the same species were seen at 21 (95%). Nesting attempts were underway (i.e. adults were incubating or young were detected) at 19 of 20 (95%) of those sites where enough time was spent to be certain of breeding activity.

Productivity of nesting raptors and reoccupancy under more natural (non-experimental) conditions can vary widely depending upon many variables (Newton, 1979, pp. 128–49). Of 126 reproductive attempts (including the test eyries) by peregrine falcons for Arizona from 1976 to 1985, 92 (73%) fledged young (Ellis, 1988). Of 12 peregrine eyries tested early enough in the nesting cycle (i.e. prior to the late nestling period) to cause failure, 10 (83%) fledged young. The reoccupancy and productivity rates for our test eyries are within or above expected values for self-sustaining populations (Newton, 1979).

Short-term behavioral responses

In this section, data on short-term responses are given in the species accounts and can be followed in data summaries in Tables 8 and 9.

Few significant or severe responses were noted for distant jet passes, so in preparing Table 8, we included only those aircraft passes that were *ca.* 150 m

TABLE 6
Productivity and Reoccupancy of Sites Tested in 1980

Species	*Site*	*1980 stimuli*	*1980 nesting success*[a]	*1981 reoccupancy by same species*	
		Number of jets:Number of booms		*present*	*nesting*
Cooper's hawk	1	32:1	+	+	+
Common black-hawk	1	0:2	+	+	+
	2	10:0	+	+	+
	3	7:0	+	+	+
Harris' hawk	1	0:1	+	+	+
Zone-tailed hawk	1	32:1	+	+	+
	2	32:0	+	+	+
Red-tailed hawk	1	14:0	+	+	+
	2	8:0	+	+	Unknown[b]
	3	8:2	+	+	+
	4	16:1	+	+	Unknown[b]
Golden eagle	1	3:1	+	+	+
Prairie falcon	1	2:1	+	+	+
	4	16:3	+	+	+
	10	14:1	–	–[c]	–
	11	19:4	+	+	+
Peregrine falcon	1	0:1	+	+	+
	2	1:0	+[d]	+	+
	3	4:0	–[e]	+	+
	4	5:1	+	+	+
	5	10:2	+	+	+
	6	6:0	+[d]	+	+
Totals	22	239:22	20/22	21/22	19/20

[a] Sites were considered successful (+) if one or more young were fledged or reared to near fledging if a post-fledging visit was not made.
[b] Only one bird seen on a brief visit.
[c] Site occupied by red-tailed hawks in 1981.
[d] For these eyries, test passes or booms occurred so late (i.e. when the nestlings were either fledged or within one week of fledging) that it was very unlikely that the test could have disrupted the breeding attempt.
[e] Reproductive effort had failed prior to test.

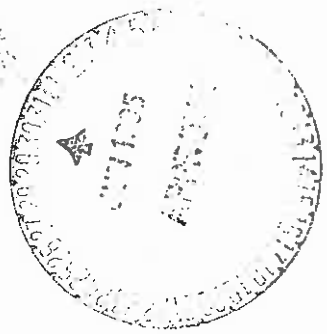


TABLE 7
Productivity of Sites Tested in 1981

Species	*Site*	*Number of jets*	*Number of booms*	*Success*[a]
Harris' hawk	1	0	2	+
Golden eagle	1	6	2	+
Prairie falcon	1	105	0	+
	4	64	9	+
	7	0	3	NA[b]
	11	229	33	+
	12	140	14	+
Peregrine falcon	1	0	9	+
	4	23	1	−
	5	16	0	−
	6	16	2	+
	7	0	3	+
	8	0	3	+
	23	60	1	NA[b]
	24	16	1	+
	25	11	1	+
	27	0	1	+[c]
	28	0	2	+
Totals	18	686	87	14/16

[a] Sites were considered successful (+) if one or more young were fledged (or reared to near fledging if a post-fledging visit was not made).
[b] Pair present but not breeding.
[c] For these eyries, test passes or booms occurred so late (i.e. when the nestlings were either fledged or within 1 week of fledging) that it was very unlikely that the test could have disrupted the breeding attempt.

or less from the birds. For many of these it was possible to determine the responses for both adults and one or more chicks. We are well aware that social facilitation is operative (i.e. that the behavior of one bird often influences the behavior of its neighbors); nevertheless, in Table 8, we treat each adult or chick response as a separate event. Of 279 adult responses, only 23 were considered significant. None were severe. Significant adult responses were most evident before egg laying and after the young were well grown. The 23 significant adult responses consisted of crouching or, very rarely, flushing from the perch site. Occasionally, adults also protest called.

Only 29 of 214 nestling responses to aircraft were judged significant (Table 8). Significant nestling responses were typically absent in young less than two weeks old. Larger young often cowered or fled deeper into the eyrie as aircraft passed.

TABLE 8
Summary of Responses of Seven Species of Raptorial Birds to Nearby, Low Level, Military Jet Aircraft[a]

Species	*Number of sites*	*Stage*	*Responses of adults*			*Response of young*		
			Insig.	*Signif.*	*Severe*	*Insig.*	*Signif.*	*Severe*
Cooper's hawk	1	Mid-nestling	14	0	0	42	0	0
Common black-hawk	1	Mid-nestling	3	0	0	3	0	0
Common black-hawk	1	Late-nestling				4	1	0
Zone-tailed hawk	2	Early-nestling	17	0	0	50	0	0
Zone-tailed hawk	2	Late-nestling	1	1	0	32	12	0
Red-tailed hawk	1	Laying period	8	0	0			
Red-tailed hawk	2	Early-incubation	16	0	0			
Red-tailed hawk	1	Early-nestling	8	4	0	42	0	0
Golden eagle	1	Early-nestling				4	0	0
Prairie falcon	4	Courtship	67	15	0			
Prairie falcon	2	Laying period	20	0	0			
Prairie falcon	4	Incubation	88	0	0			
Prairie falcon	1	Early-nestling	4	0	0			
Peregrine falcon	1	Courtship	1	0	0			
Peregrine falcon	2	Mid-nestling	0	2	0	8	16	0
Peregrine falcon	1	Non-breeding	9	1	0			
Totals 7 species	21	Various	256	23	0	185	29	0

[a] We included only those aircraft passes that were about 150 m or less from the birds. A response was tallied for each bird/aircraft episode (i.e. one jet pass near three nestlings was counted as three bird responses). Response alternatives are displayed in Fig. 3. Because responses were observed for some sites during various stages, site total is not a column total.

TABLE 9
Summary of Responses of Seven Species of Raptorial Birds to Real and Simulated Sonic Booms[a]

Species	*Number of sites*	*Stage*	*Responses of adults*			*Response of young*		
			Insig.	*Signif.*	*Severe*	*Insig.*	*Signif.*	*Severe*
Common black-hawk	1	Incubation	2	0	0			
Harris' hawk	2	Late-nestling	2	3	0	7	0	0
Zone-tailed hawk	1	Late-nestling				2	0	0
Red-tailed hawk	1	Laying period	1	0	0			
Red-tailed hawk	1	Incubation	1	0	0			
Red-tailed hawk	1	Mid-nestling	0	1	0	3	0	0
Golden eagle	1	Mid-nestling	0	1	0			
Golden eagle	1	Late-nestling				1	1	0
Prairie falcon	1	Courtship	3	2	0			
Prairie falcon	4	Incubation	38	0	0			
Prairie falcon	1	Mid-nestling	3	0	0	4	0	0
Prairie falcon	2	Late-nestling	0	1	0	2	0	0
Prairie falcon	1	Non-breeding	2	2	0			
Peregrine falcon	3	Courtship	7	1	0			
Peregrine falcon	1	Laying period	0	2	0			
Peregrine falcon	1	Incubation	2	0	0			
Peregrine falcon	2	Mid-nestling	2	2	0	3	0	0
Peregrine falcon	2	Late-nestling	2	2	0			
Peregrine falcon	3	Post-fledging	0	1	0	2	4	0
Peregrine falcon	2	Non-breeding	0	3	0			
Totals 7 species	27	Various	65	19	0	24	5	0

[a] We included only those booms that were 112 dB or greater. A response was tallied for each bird/boom episode (i.e. one boom near three nestlings was counted as three bird responses. Response alternatives are displayed in Fig. 3. Because responses were observed for some sites during various stages, site total is not a column total.

Table 9 reports adult and nestling responses for booms at 27 nesting sites of seven species. Of 84 adult responses, 65 were insignificant: none were severe. Flushing was the typical significant adult response. Incubating or brooding adults never burst from the eyrie, endangering their offspring. Of 29 responses of young birds, only five were significant. Of these five, three were fledged peregrines flushing in response to nearby booms when, unfortunately, the observer was also visible.

Bald eagle (*Haliaeetus leucocephalus*)—No direct observations of bald eagles were made. However, the endangered status of this species prompts the inclusion of what information is available. Bald eagles are known to occasionally attack light aircraft near active nests (White & Sherrod, 1973). There are some unpublished observations of bald eagle responses to stimuli like those used in this study. Bald eagles have nested near a gunnery target subject to F-4 straffing runs at McDill Air Force Base (AFB), Tampa, Florida (David Kleintz, FWS, Houston, Texas and John Shirtz, Environmental Office, McDill AFB, pers. comm.) and near artillery ranges on the Aberdeen Proving Ground, Maryland. In 1980, a pair successfully fledged one young from a nest within 200 m of the projectile path and midway between the artillery firing position and the impact zone (William S. Clark, Raptours, Alexandria, VA and William Russell, Aberdeen Proving Ground, MD, pers. comm.). The extreme tolerance of these individuals, while remarkable, may not be typical for the species.

In a detailed study of bald eagle responses to five classes of human activity, Grubb and King (1991) found that pedestrian traffic was most disturbing, while aircraft traffic was least disturbing to nesting birds. However, they concluded that aircraft within 100 m of free-ranging bald eagles would result in at least minimal responses 75% of the time. Distance appeared to be the most important factor in determining probability and severity of response levels, followed (in decreasing importance) by duration, visibility, number, position, and noise level.

Cooper's hawk—In the few tests involving this species, the adult female and large young responded insignificantly to jet aircraft only 100 m overhead.

Common black-hawk—The most common response to stimuli by both adults and young was 'alerting'. On one extremely close pass (100 m overhead), a fledgling crouched (cowered) for 4 s.

Harris' hawk—The Harris' hawk nests over much of the Sells MOA where sonic booms and low-level jet passes are frequent. Unfortunately, in our trials, the observers were in full view of the test birds. In three instances, adults fled from the nest after the simulated sonic boom. In each case, nestlings were old enough not to require parental attention during these absences. We believe that the adults were responding more to our presence than to the boom; however, the situation deserves further inspection.

Zone-tailed hawk—In response to multiple passes, adults and young were most often only 'altered'. Adult crouching was seen once, although some jet passes were within 100 m. Older nestlings crouched 12 of 32 times. Once an adult female continued feeding chicks when A-10's passed within 150 m. Nestling responses to the only simulated boom were insignificant.

Red-tailed hawk—This species appeared remarkably tolerant of low-level jet traffic. Once an adult flew toward two approaching A-10's (150 m overhead) and entered the nest. In another instance, as four A-7's passed within 100 m, an adult female reached into the nest and swallowed the remains of a small mammal.

By contrast, adult responses in two of three trials with simulated booms were significant. In the most extreme response, an adult female interrupted a feeding bout and leapt out of the nest, even though the rocket was hidden by the cliff and the observer was well-concealed in a blind to which the birds had become accustomed. More boom trials are needed with this species. In the light of the relative abundance of nesting red-tailed hawks on the Sells MOA and Fort Luke Air Range, where sonic booms are common, it seems unlikely that this species exhibits a productivity-limiting response to this stimulus. Indeed, all of our experimental red-tailed hawks nested in high-aircraft-use areas, and all fledged young.

Golden eagle—Golden eagles appear to be much more sensitive to humans near their nests than the other species studied. From our few data, this hypersensitivity to humans on foot is not reflected in a greater sensitivity to sonic booms and low-level jets. In 1980, two golden eagle eyries were found along a heavily used low-level jet corridor. Both fledged young. Golden eagles are also frequently observed in the desert mountains of the Fort Luke Air Range where sonic booms and low-level jets are regularly encountered.

In this study, one large nestling responded to an extreme boom (*ca.* 141 dB) by cowering momentarily. On one trial, an adult fled following a propane cannon blast. However, the bird may have been responding not only to the blast, but also to the presence of a distant observer.

At a golden eagle eyrie in Montana in 1971, an adult female exhibited alarm reactions to nearby lightning and thunder, but showed no detectable behavioral response to loud thunder claps when lightning was not visible.

Prairie falcon—In most cases. jet passes, even within 50 m, elicited insignificant responses. Occasionally, adults attending young flushed after repeated passes; however, they always returned within 1 min. Twice during the courtship period, an adult female fled as low-level jets approached from a distance. On one occasion, a non-breeding falcon left the cliff and flew out of sight after the last of three booms. Unfortunately, a distant observer was visible, confusing the results.

From Table 8, adults of this species appear to be more sensitive to

disturbance during the courtship period when raptors of many species are most prone to abandon (Fyfe & Olendorff, 1976). Reoccupancy and reproductive rates (Tables 6 and 7) were excellent for the test birds (Fig. 1 and Table 8). All but one pair in 1980 and all breeding pairs in 1981, including the four pairs impacted by A-10's on an *ad libitum* basis, fledged young.

Surprisingly, low-level jets caused alarm less often than did booms. Our interpretation is that the falcon sees the aircraft approaching, evaluates the danger, and responds without alarm, whereas the falcon has no early warning for a sudden boom, and as a result, sleeks its plumage and looks rapidly about attempting to discover the source of the stimulus.

Incubating adults seldom arose following even the most alarming stimuli. Interestingly, on the few occasions when adults did leave the eyrie, they did not burst forth and thereby endanger eggs or small young as observed in response to other alarming stimuli (Cade, 1960; White & Sherrod, 1973), rather they walked to the eyrie lip, then launched in a controlled manner.

Peregrine falcon—Stimulus levels for this species are reported in Fig. 2. Because recent peregrine falcon eyries in Arizona are generally out-of-sight on broad ledges of tall cliffs (average height 152 m, N = 41; Ellis, 1982), we obtained direct observations of adults in the eyrie at only four sites. More often, we observed the responses of adults and young while they perched on the breeding cliff or flew.

In general, the peregrine falcons responded much like the prairie falcon. Large nestlings responded to nearby jets by fleeing into the eyrie. While soaring, two recently fledged juveniles showed no fear or avoidance during repeated passes of nearby jets. Adults were typically alerted or alarmed by the stimuli, and, in response to booms, they flew out and circled more frequently than did prairie falcons. Unfortunately, most of our data on booms are confused by sight of the observers or the explosive canister. We obtained no evidence of site abandonment or reproductive failure resulting from our tests. All sites tested in 1980 were reoccupied in 1981.

During the 1980s, the Arizona population was expanding and reproducing at a 'normal' (Ratcliffe, 1980, p. 240–1) rate (i.e. 1·7 young fledged/breeding attempt and 2·3 young fledged/successful attempt: Ellis, 1988), while exhibiting moderate (14·2%: Ellis *et al.*, 1989) eggshell thinning. Because we found no correlation between eggshell thickness or productivity and level of responsiveness to booms or jets, the data are not presented here. However, populations more severely stressed by chlorinated hydrocarbon pesticides or other toxins may respond more negatively.

An interesting observation made in the Queen Charlotte Islands, British Columbia, Canada, suggests that peregrines may be moderately annoyed by noises at certain frequencies. R. Wayne Nelson (Camrose, Alberta, Canada,

pers. comm.) observed incubating adult(s) repeatedly headshake (an action pattern used to dispel debris from the head or to express displeasure) in response to the high-pitched foghorn whistle at a nearby lighthouse.

Captive falcon experiments

Captive peregrine falcons were observed during nine sessions involving 64 low-level jet passes. Responses were insignificant 63 times. The most extreme response occurred when the tiercel attempted to fly during the third jet pass in a series of six low-level passes. However, we were not certain if he was responding to the jet or merely bating (attempting to fly) as typical for captive falcons. The intervals between stimuli and first relaxed behavior were of short duration, usually less than 10 s and rarely as long as 30 s. On several occasions, the female circled below (sometimes within 60 m of) approaching A-10's and, with no apparent hesitation, pursued, and even captured, prey, as the aircraft swept overhead. Similarly, during seven bouts involving 16 simulated sonic booms, all observed responses were insignificant.

Heart rate experiments

Usable HR data were received about 5% of the time with two telemetering eggs and two natural eggs in one prairie falcon eyrie. System disfunction was caused by the incubating adult not being in close contact with the

TABLE 10
Heart-rate (HR) Changes Following Alighting from Flight and Settling to Incubate in Prairie Falcons (Site 11:81)

Date	*Time*	*Sex*	*Heart-rate parameters*				
			Initial rate[a]	*5-min rate*[b]	*Rate asym*[c]	*Time asym*[d]	*Difference*[e]
31 March	0928	M	200	164	156	5·5	44
1 April	1502	F	240	174	160	9	80
9 April	1225	F	240	192	176	15	64
23 April	1310	F	176	148	132	8	44

[a] Initial rate: first HR recorded after falcon alights.
[b] 5-min rate: HR at 5 min after beginning to settle.
[c] Rate asym: post-flight asymptote, the lower asymptote of HR values approached after settling to incubate.
[d] Time asym: time from initial rate until HR reaches an approximate lower asymptote.
[e] Difference: initial rate minus rate asymptote.

TABLE 11
Heart Rate (HR) Responses of Incubating Prairie Falcons (Site 11:81) Subjected to Military Jets

Date	*Time*	*Sex*	*Stimulus*	*Heart rate parameters*						*Evaluation*[g]
				Pre-stim. rate[a]	*Post-stim. peak*[b]	*5-min rate*[c]	*Time ret*[d]	*Rate asym*[e]	*Time asym*[f]	
31 March	0945	M	Two loud distant jets	160	178	175	5	168	6	Short-term minor change
31 March	1244	F	A-10, two passes: 80–250 m horiz., 0–50 m up	168	168	168	0	168	0	No change
31 March	1517	F	A-7, seven passes: high overhead	180	180	180	0	180	0	No change
31 March	1557	F	A-7, eight passes: 100–250 m horiz., 0–100 m up	145	164	152	5	145	6	Short-term minor change
14 April	1512	F	A-10, four passes: 100–150 m horiz., 0–50 m up	188	arose	176	5	172	<8	Falcon arose
22 April	0839	F	F-4, nine passes: high	124	arose	158	35	152	3	Falcon arose
22 April	1335	F	F-4, two passes: high but loud	180	180	172	0	172	5	No change

22 April	1401	F	F-4, one pass: high but very loud	172	172	172	0	172	0	No change
23 April	1138	M	A-10, two passes: 500 m overhead	224	220	216	0	216	4	No change
23 April	1329	F	jets, eight loud passes	128	160–180	124	2	120	3	Minor change after first and second passes
23 April	1636	F	A-7, four passes: 60–90 m horiz., at eyrie level	132	160	140	3	132	4	Minor change

[a] Pre-stim rate: Pre-stimulus HR. Resting HR for the male was 168–200 ppm ($\bar{x} = 191$, $n = 7$); for the female 132–185 ppm ($\bar{x} = 150$, $n = 19$).
[b] Post-stim peak: Post-stimulus HR peak. Because the data display is not a continuous line, the value reported here is an approximate average rate for 0·5 min following the stimulus. Higher instantaneous peak rates are evidenced in the scatter pattern.
[c] 5-min rate: HR at 5 min after stimulus.
[d] Time ret: Time from stimulus until the HR returns to the pre-stimulus rate. HR naturally fluctuates widely and when a pre-stimulus rate was very low, it sometimes was not encountered again for an extended period even though the HR leveled off at a normal level, hence the post-stimulus lower asymptotic is also treated in the table.
[e] Rate asym: Post-stimulus asymptote, the lower asymptote of HR values approached after the stimulus.
[f] Time asym: Time from the stimulus until the post-stimulus HR asymptote is achieved.
[g] When falcons were most disturbed, they arose leaving no immediate HR record.

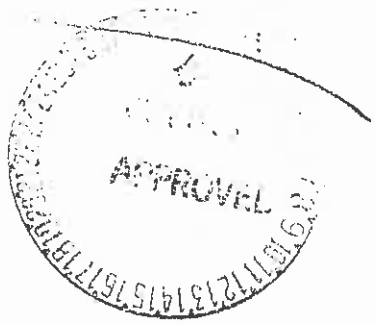


TABLE 12

Heart Rate Records of Incubating Prairie Falcons (Site 11:81) Subjected to Simulated Booms

Date	*Time*	*Sex*	*Stimulus*[a]	*Heart rate parameters*[b]						*Evaluation*
				Pre-stim rate	*Post-stim peak*	*5-min rate*	*Time ret*	*Rate asym*	*Time asym*	
9 April	1255	F	Three propane cannon booms	168	F readjusted position so signal temporarily lost	152	0:30	152	4	Minor or no change
9 April	1322	F	One propane cannon boom	152	152	144	0	144	4	Insignificant change
9 April	1348	F	One propane cannon boom	140	164	144	ca 7	140	7	Minor change
9 April	1752	F	One propane cannon boom	140	140–160	140	0:10	140	0	Minor change
9 April	1803	F	Three propane cannon booms in ca. 1 min	140	ca. 168	148	ca. 6	144	2	Minor change
9 April	1814	F	Five propane cannon booms in ca. 2 min	140	ca. 180	140	ca. 5	140	6	Moderate change
9 April	1914	F	Seven propane cannon booms in 2·5 min	104	140	ca. 112 at 4 min	—	—	—	Moderate change
15 April	0323	F	One mortar salute	136	160	152	30	152	3	Minor change
16 April	1458	F	One mortar salute	132	125	136	0	132	8	No change
22 April	1201	M	One mortar salute	ca. 192	Arose, flew, resettled in 4 min	—	8 min HR = 150	140	18	Heart rate dropped upon resettling
22 April	1733	F	One mortar salute	104	Arose, stood in entrance 3 min	120	32	108	8	Moderate change

[a] All booms generated 300 m from nest cavity.

[b] For explanation of column headings, see footnotes for Table 11.

telemetering egg. Enough data were gathered using the system, however, to provide a preliminary evaluation of HR responses to the study stimuli.

We compared resting HR, and HR following flight (Table 10), then examined HR's of incubating adults following passage of low-level jets (Table 11) and simulated sonic booms (Table 12). HR proved highly variable. For any 2·5 min block, the HR typically varied by 25–30 bpm. Similarly, gradual changes in average rate over a day were also evident. HR's following booms and jet passes were comparable or below HR levels for falcons returning from flight. In addition, post-flight and post-stimulus HR's were comparable in the amount of time required to return to resting asymptote.

CONCLUSIONS

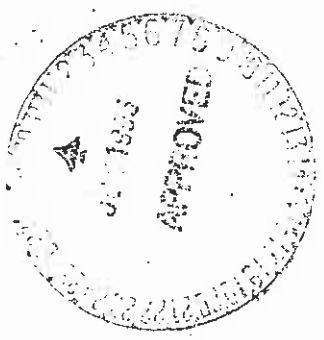
We found that wild breeding raptors, when subjected to worst case levels of low-level jet passes and simulated sonic booms, were often noticeably alarmed, and, in a few instances, adults temporarily left nest sites. However, significant negative responses were the exception, and when they occurred, they did not appear to limit productivity or reoccupancy. In many cases, the birds ignored all test stimuli. We conclude that the test stimuli had no extreme (short- or long-term) adverse effects on the study individuals. We emphasize, however, that the birds observed were not (except for nestlings and fledglings) naive, nor did we, to the best of our knowledge, experiment with falcons that were heavily contaminated with pesticides. Further, habituation to test stimuli, due to previous exposure, may have produced the minimal response levels we frequently observed. However, our experiments sometimes involved raptors nesting at eyries far from zones of frequent military aircraft activity and often involved closer, louder, and more frequent disturbances than would have been likely even for the eyries in zones where mid- to high-altitude sonic booms and low-level jet aircraft are frequent.

Short-term behavioral responses

Much individual variation was observed; however, some broad generalizations are outlined below:

A. Responses to jet aircraft

1. Small (downy) nestlings did not respond noticeably.
2. Large nestlings (contour feathers emerging) in exposed nests (e.g. stick nests in trees) were alerted by, and sometimes cowered below, the closest aircraft (100 m or less).



3. Large nestlings in cavity nests often fled into the cavity and cowered in response to the closest aircraft.
4. Large nestlings were alerted by distant aircraft (greater than 300 m), but showed no alarm.
5. Adults ignored or casually watched craft greater than 500 m distant.
6. Adults were normally alerted or alarmed by craft closer than 300 m. Occasionally, adults ignored but some fled from the closest aircraft.
7. Non-breeding or pre-breeding prairie falcons were more likely to flush and/or flee in response to test stimuli than pairs attending eggs or nestlings.
8. Adult behavior suggesting that site abandonment was imminent was not observed.
9. Nestling behavior suggesting that premature fledging was imminent was not observed.

B. Responses to booms

1. Small nestlings did not respond noticeably.
2. Large nestlings were alerted or alarmed or, less often, they cowered.
3. Adults were frequently alerted or alarmed by extreme booms. Occasionally, adults gave no apparent response to very loud booms; however, some birds briefly fled in response to loud booms.
4. Adult behavior indicative of offspring endangerment or site abandonment was not observed.

Long-term behavioral responses

The reproductive rates for test eyries in 1980 and 1981 and reoccupancy rates for sites experimentally disturbed in 1980 were at or above normal.

Some cautionary notes

Although the reproductive performance of test birds in this study did not appear to be negatively affected, decreased productivity, although unlikely, may result from similar stimulus levels in these same raptors in other areas, or in raptors of other species. Birds may also respond quite differently to helicopters or other types of aircraft.

The boom-generating devices used in this study approximated the overpressures of mid- and high-altitude sonic booms. Although we have no records for raptor responses to the extreme booms produced by low-level supersonic jet aircraft, we expect that extreme panic reactions would result.

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This study was a joint US Air Force–US Fish and Wildlife Service venture. Chuck Kennedy (US Forest Service) rattled beauracratic chains to generate interest in the project. Lewis Shotton (Langley AFB) nursed the study into being, arranged Pentagon level support, and coordinated Air Force funding. David Langowski (FWS, Albuquerque) arranged for support from his agency and contributed to project design. John Hubbard (New Mexico Game and Fish Department) arranged for the study to be performed in Arizona. Dan Davis, Ralph Patey, and Chuck Higgins (Arizona-Sonora Desert Museum) administered funds during 1980. Don Holtz (Engineering-Science, Inc.) expedited payments in 1981. Most of the fieldwork was conducted through the Institute for Raptor Studies, Oracle, Arizona. Several biologists participated in the field: most significantly, Jim Dawson and Jim Fackler.

Others provided essential support. Eduardo O. Gonzales Ruiz (Director of the Argentine Wildlife Service) made special arrangements for our austral peregrine falcon capture and export permits. Terry B. Roundy and W. Guillermo Vasina assisted with importation–exportation and quarantine arrangements. Clayton M. White generously provided quarantine facilities for the falcons at his breeding facility at Brigham Young University. The US Forest Service, Navajo Nation, and Bureau of Land Management allowed tests on lands under their control. David E. Andersen, Mark R. Fuller, Charles J. Henny, and Brian Millsap assisted in manuscript review.

Wing Commanders at Davis Monthan AFB, the Tucson Air Guard, and Luke AFB authorized sorties. Major Frank Barrett scheduled perhaps 90% of the flights with Lt. Col. John Brick assisting when needed. Without the persistent support of these two officers, the project would certainly have failed. Finally, we give special thanks to Bucket, Fuzzy, Rancho, Knife, Limey, Crocus, and the many other US Air Force (and alien) pilots who skimmed the falcon crags to our aid.

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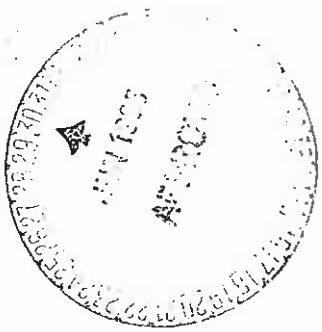

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ATTACHMENT 4

BIOLOGICAL REPORT: WILDLIFE AND HABITAT RECONNAISANCE
OF PROPOSED LIFE OF MINE COAL RESOURCE AREAS,
BLACK MESA AND KAYENTA MINES, BLACK MESA ARIZONA
(Includes the N99 Area)

Introduction to Attachment 4, Biological Report: Wildlife and Habitat Reconnaissance of Proposed Life of Mine Coal Resource Areas, Black Mesa and Kayenta Mines

In support of possible future mining in the remaining unmined coal resource areas within PWCC's Black Mesa leasehold, wildlife baseline studies were conducted in these areas during 2003. The survey areas are generally described as life of mine coal resource areas (LOMCRA). Within the LOMCRA, are individual coal resource areas such as J2/J15, J8, N9, etc. Included in the survey area is the N12/N99 south and N99 north areas. Specifically, the N12/N99 south survey area corresponds to the N99 area included in the five year mine plan revision. The information in the report is germane to the N99 area because it describes wildlife resource findings for much of the leasehold that contains habitat similar to that in the N99 area. The broader investigation is beneficial in that it evaluates for the presence of species that are mobile and may have the potential to occur in the N99 area.

BIOLOGICAL REPORT:

Wildlife and Habitat Reconnaissance of Proposed Life of Mine Coal Resource Areas, Black Mesa and Kayenta Mines, Black Mesa, Arizona

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Abstract

In 2003, PWCC evaluated several coal resource areas on the Black Mesa leasehold for life of mine planning. This report details the TES, other wildlife resources, and wildlife habitats found on the proposed Life of Mine Coal Resource Areas (LOMCRAs). The areas that were surveyed as part of this biological survey included the J2/J15, J4, J5/J6/J13/J14, J8, J9/J10, N9, N10, N99 North, and N12/N99 South LOMCRAs. Wildlife species are similar across all LOMCRAs, with large ungulate sign more frequently observed on the northern LOMCRAs. A total of 7 mammalian species, 23 avian species, and 5 herpetile species were identified on the LOMCRAs. A total of 16 listed species were identified by the Navajo Natural Heritage Program (NNHP) as occurring or potentially occurring on or near the LOMCRAs. Surface disturbance activities may affect habitat for the Navajo Mountain Mexican vole. Surface disturbance activities may also affect suitable breeding habitat for five other species listed by the NNHP. However, the potential for these five species to occur on these LOMCRAs is slim. There are no records for the black-footed ferret, the mountain plover, the kit fox or the Townsend's big-eared bat and all but one of these species (the Townsend's big-eared bat) are unlikely to occur on the mine leasehold. Navajo Mountain Mexican vole habitat is present in the N10, N99 North, and the J2/15 LOMCRAs. The total acreage of suitable habitat for this species in each of these LOMCRAs is 40.8, 27.8, and 1.6 acres respectively for a total of 70.2 acres affected in the LOMCR study areas. Raptor surveys for breeding northern goshawks were conducted in the N99 North and N10 areas. No northern goshawks were documented during surveys.

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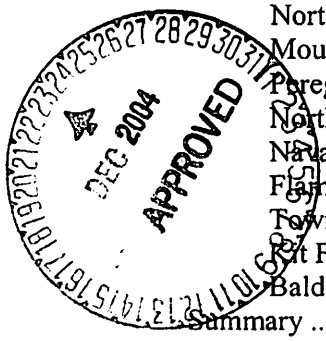

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Map 1. LOMCRA Study Areas and Potential TES Habitat
Map 2. Northern Goshawk Survey and Raptor Responses.

ATTACHMENT B:
Photos 1-4. LOMCRA Study Area Photos

Introduction

Peabody Western Coal Company (PWCC) contracted BIOME, Ecological and Wildlife Research (BIOME) to conduct wildlife studies in certain areas on the Black Mesa leasehold scheduled for future mining. These studies consisted of general wildlife, threatened, endangered, and sensitive (TES) species inventory and monitoring for the purpose of augmenting the original baseline studies conducted in and surrounding the Black Mesa leasehold. The results of these studies, in conjunction with the results of the original baseline work, support the application to include the new areas in the Life-of-Mine Plan for the Black Mesa and Kayenta Mines.

This report details the TES, other wildlife resources, and wildlife habitats found on the new Life of Mine Coal Resource Areas (LOMCRAs). The original baseline wildlife studies of the Black Mesa leasehold, conducted in three phases from 1979 through 1983, were completed in order to qualitatively and quantitatively describe the wildlife and wildlife habitats in and immediately surrounding the entire Black Mesa leasehold. The results of these studies were presented in Chapters 9 and 10 of the Permit Application Package (PAP, PWCC 1985) for the Black Mesa and Kayenta Mines.

The 2003 studies used the latest tribal, state, and federal lists of TES species to determine which species have the potential to occur on the Black Mesa leasehold. The work was conducted seasonally, focusing on the spring and fall migration periods for avian species, in order to obtain representative results. The remainder of this report details the results of surveys conducted during the 2003 field season and a summary of the knowledge currently known about the LOMCRAs.

Data was collected for this report by general reconnaissance surveys for TES species habitats, spring and fall avian surveys, and delineation of potential TES species habitat within each LOMCRA. Such wildlife monitoring activities will serve to address potential direct impacts to wildlife, TES species, and potential habitat for TES species, resulting from continuation of mine activities.

To determine the potential impacts to TES and wildlife species on the LOMCRAs, BIOME conducted the following activities on the Black Mesa Mine during the 2003 field season:

1) A general reconnaissance for TES species and potential TES species habitats in each of the LOMCRAs where future mining may occur,
2) Spring and fall general avian surveys,
3) A delineation of suitable habitat for TES species within each LOMCRA, and
4) A historic data search of wildlife known, or with potential to occur, within or near these areas,
5) Raptor surveys, focusing on presence of northern goshawk, in selected LOMCRAs.

Proposed LOMCRAs

The Black Mesa leasehold lies on the north-central portion of the Black Mesa monocline and the habitats represented on the leasehold are entirely Great Basin cold desert woodlands, particularly pinyon-juniper woodland (Brown 1994), and cold desert habitats, particularly sagebrush shrubland. There are currently five active mining areas on the 65,000-acre mine leasehold. In anticipation of future mining activities on the leasehold, 9 additional LOMCRAs were surveyed to determine the potential for TES species or suitable habitat to occur on them. The areas that were surveyed as part of this biological survey included the J2/J15, J4, J5/J6/J13/J14, J8, J9/J10, N9, N10, N99 North, and N12/N99 South LOMCRAs (Attachment B, Drawing 1).

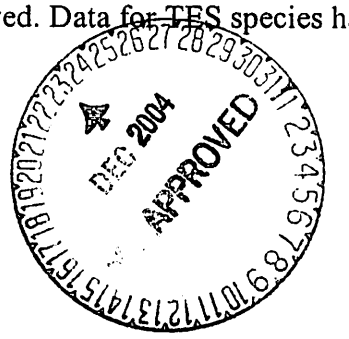
Each LOMCRA varies with regards to the quantity of woodland canopy coverage, age of woodland present, density and coverage of woody shrub cover, and soils present. Important habitats found on the LOMCRAs include contiguous sagebrush flats, mid to late-seral pinyon-juniper woodland, ephemeral drainages, and sandstone bluffs. Contiguous sagebrush shrubland has been identified as important habitat for a Group 4 (NESL) species, the Navajo Mountain Vole (*Microtus mexicanus navaho*). Mid to late seral woodlands represent potentially suitable breeding habitat for forest raptors including Cooper's hawks (*Accipiter cooperi*) and northern goshawks (*Accipiter gentilis*). Ephemeral drainages, including Coal Mine Wash, Moenkopi Wash, and Yellow Water Wash support thin strands of salt cedar (*Tamarisk ramossissima*) in some areas and provide habitat for migrant songbirds and rodents (including the Navajo Mountain Mexican vole). Sandstone bluffs provide preferred breeding habitats for red-tailed hawks (*Buteo jamaicensis*).

Elevation of the LOMCRAs ranges from 6,100 feet in elevation on the southern end of the leasehold (i.e. mine area J8) to approximately 6,900 feet at the northern end of the leasehold (i.e. mine area N10). Numerous large drainages dissect the proposed LOMCRAs, but habitat within these features will have minimal impacts from mine-related activities. Soils on the LOMCRAs vary from shallow to moderate depth and are predominantly composed of sandstone and shale derivatives.

Methods

Field Reconnaissance

A field reconnaissance of each LOMCRA was conducted to identify important habitats, determine the need for species-specific surveys, and produce a species list of vertebrates on each LOMCRA. Pedestrian transects, vantage point observations, and directed reconnaissance of important habitats was used to determine the suitability of each LOMCRA for TES species. During the reconnaissance of each extension area a list of all avian, mammalian, and herpetile species, identified directly or indirectly (scat, tracks, etc.), were recorded. Field maps were used to delineate potentially suitable habitat for TES species and to record the locations of individual species of interest. Photos were taken of habitats within LOMCRAs and of representative LOMCRAs. GPS coordinates were taken at locations where TES species were suspected or observed. Data for TES species have been included on the final map (Attachment A, Map 1).



Historic Data Search

The original baseline wildlife studies of the Black Mesa leasehold, conducted between 1979 and 1983, identified the important habitats on, and within the two-mile buffer area, of the Black Mesa leasehold. The results of these studies were presented in the PAP for the Black Mesa and Kayenta Mines (PWCC 1985). Using these reported data collected by PWCC in past years, we identified records of TES species on or near proposed LOMCRAs. This information was used to identify important habitats on LOMCRAs, and to focus reconnaissance efforts during the field surveys.

Raptor Surveys on Selected LOMCRAs

Species-specific surveys for northern goshawks and other raptors were conducted during the 2003 field season in LOMCRAs N99 North and N10 (Attachment A, Map 2). Survey methods followed those described by Joy et al. (1994). Two field surveys were conducted, the first survey during the last week of May and the second survey during second week of July. Areas around proposed borehole/corehole locations were checked for the presence of stick nests in potentially suitable trees. Calling stations were set approximately 970 feet apart within suitable habitat to attain complete coverage of the survey area. A battery amplified power horn was used to broadcast northern goshawk alarm calls for 2 minutes at each calling station followed by a 2-minute listening period. This process was repeated to provide a total of 8 minutes of calling/listening time per calling station. All raptor species, whether responsive to call or incidentally observed, were documented at and between calling stations.

NESL Species Assessments

A list of threatened, endangered, and sensitive (TES) species potentially occurring on the Black Mesa leasehold was derived using the March 2001 Navajo Endangered Species List (NESL) published by the Navajo Natural Heritage Program (NNHP). Species were included on the list based on habitats present on the Black Mesa leasehold, documented records of listed species from historical biological surveys, and personal knowledge of the fauna of the region.

Results

LOMCRAs

The proposed LOMCRAs encompass 15,019 acres of the approximately 65,000-acre leasehold. Individual acreages of each LOMCRA are provided in Table 1. Not all LOMCRAs listed in Table 1 were surveyed as part of this project. Those LOMCRAs with previous data were excluded.

Table 1. LOMCRAs on the Black Mesa leasehold.

LOMCRA	Affected Acres
J2/J15	1664
J4	524
J8	717
J9*/10	1142
N9	2345
N10	1795
N12/N99 South	2778
N99 North	1711
J5/6/13/14	2343

*Area previously surveyed (see SWCA 2000).

Each LOMCRA varied in the amount of woodland coverage, drainages, shrubland, and open habitats present. The most northern LOMCRAs (N9, N10, and N99) have mid to late seral pinyon-juniper woodland that is well developed in some areas (Attachment B, Photo 1). Tree species include pinyon pine (*Pinus edulis*), Gambel oak (*Quercus gambelii*), and Utah juniper (*Juniperus osteosperma).* Utah juniper dominates many of the lower, drier woodland areas, but denser pinyon-dominated stands occur at higher elevations or areas with more mesic site conditions. Gambel oak also becomes a common inclusion in these areas. This habitat is typified by a canopy height of less than 30 feet with some mid-story shrub or tree component. Ground cover varies, but is dominated by woody perennial plant species including big sagebrush (*Artemesia tridentata*), cliffrose (*Cowania mexicana*), and four-wing saltbush (*Atriplex canescens*). Herbaceous composition can be diverse, but overall cover is sparse.

The southern LOMCRAs (J2/15, J5/6/13/14, J4, and J8/9/10) are all characteristically low in woodland coverage and although pinyon-juniper woodland is present in all of these areas, the density of trees, usually represented by Utah juniper, is low (Attachment B, Photo 2). Canopy height over most of these areas is less than four feet and is dominated by woody shrubs, mostly big sagebrush. Other shrub species on the southern LOMCRAs include cliffrose, snakeweed (*Gutierrezia sarothrae*), black greasewood (*Sarcobatus vermiculatus*), and four-wing saltbush. Herbaceous species coverage is somewhat greater in these shrubland types and include blue grama (*Bouteloua gracilis*), Indian ricegrass (*Oryzopsis hymenoides*), galleta (*Hilaria jamesii*) and globemallow (*Sphaeralcea* sp.). Detailed vegetation studies are presented in the PAP, Chapter 9, Vegetation Resources.

Wildlife species are similar across all LOMCRAs, with large ungulate sign more frequently observed on the northern LOMCRAs. This however was not numerically quantified. Observations of ungulates included four mule deer in N99 North, six mule deer at the north end of the N10 LOMCRA, and numerous sign of mule deer and elk (pellet groups) within N9 North,

N10, N99 North, N12/N99 South, and J2/15. Other observed wildlife included several mammal species, numerous avian representatives, and typical Great Basin herpetofauna. A list of vertebrate species observed during the field reconnaissance is presented in Table 2.

Table 2. Vertebrate species observed during LOMCRA field reconnaissance.

	Scientific Name	Common Name
Mammals	*Canis latrans*	Coyote
	Cervus elaphus	Rocky Mountain elk
	Lepus californicus	Black-tailed jackrabbit
	Neotoma sp.	Woodrat
	Odocoileus hemionus	Mule deer
	Spermophilus variegatus	Rock squirrel
	Sylvilagus audubonii	Desert cottontail
Birds	*Amphispiza belli*	Sage sparrow
	Aphelocoma californica	Western scrub-jay
	Baeolophus ridgwayi	Juniper titmouse
	Buteo jamaicensis	Red-tailed hawk
	Carpodacus mexicanus	House finch
	Cathartes aura	Turkey vulture
	Chondestes grammacus	Vesper sparrow
	Corvus corax	Common raven
	Dendroica nigrescens	Black-throated gray warbler
	Empidonax wrightii	Gray flycatcher
	Falco sparverius	American kestrel
	Gymnorhinus cyanocephalus	Pinyon jay
	Myiarchus cinerascens	Ash-throated flycatcher
	Pipilo maculatus	Spotted towhee
	Poecile gambelli	Mountain chickadee
	Polioptila caerulea	Blue-gray gnatcatcher
	Psaltriparius minimus	Bushtit
	Sayornis saya	Say's phoebe
	Sialia currucoides	Mountain bluebird
	Sialia mexicana	Western blue bird
	Sitta carolina	White-breasted nuthatch
	Spizella passerina	Chipping sparrow
	Tachycineta thalassina	Violet-green swallow
	Thryomanes bewickii	Bewick's wren
Herpetiles	*Cnemidophorus* sp.	Whiptail lizard
	Crotophytus collaris	Collared lizard
	Sceloporus graciosus	Sagebrush lizard
	Sceloporus undulatus	Fence lizard
	Uta stansburiana	Side-blotched lizard

Raptor Surveys on Selected LOMCRAs

A total of 14 calling stations were visited in the N10 LOMCRA and 30 stations were visited in the N99 North LOMCRA (Attachment A, Map 2). One historic red-tailed hawk (*Buteo jamaicensis)* nesting location in the N99 North LOMCRA was visited during each survey period to determine the status of the nest. This nest remained inactive during the entire 2003 field season and little remains of the original nest.

N99 North LOMCRA Survey

A single American kestrel (*Falco sparverius*) was observed on two occasions (6 May and 16 July). This individual was a male and was observed in approximately the same location during both survey periods; it is likely that the same individual was observed on both occasions. Other avian species observed during surveys included pinyon jays, Bewick's wren, Juniper titmouse,

rock wren, house finch, gray flycatcher, Blue-gray gnatcatcher, Black-throated gray warbler, plumbeous vireo, dark-eyed junco, bushtit, ruby-crowned kinglet, ash-throated flycatcher, hairy woodpecker, and common raven. Several pair of pinyon jays were observed actively building nests in the southeastern portion of the N99 North area, closest to the N14-D pond.

N10 LOMCRA Survey

On the morning of the first survey, a male Cooper's hawk was observed on the ridge to the east of Yellow Water Canyon, approximately 1.5 miles north of the N10 LOMCRA. This bird was soaring and displaying hackles, suggesting the bird may have been in the early stages of breeding. A male American kestrel was observed on 30 April in the western portion of the N10 LOMCRA. This bird did not respond to calling, but flew north into Yellow Water Canyon. The same individual (assumed) was seen in the vicinity of the first location later in the season, but was not identified during the second survey period. A single red-tailed hawk was observed in a small canyon on the north-central portion of the N10 LOMCRA. This bird was soaring and flew north out of the LOMCRA and no additional observations of this species were recorded in this location during the field season. Other avian species observed during surveys of the N10 LOMCRA included pinyon jay, white-breasted nuthatch, gray flycatcher, green-tailed towhee, scrub jay (carrying food), Bewick's wren, violet-green swallow, juniper titmouse, and Cassin's kingbird. Both the pinyon jays and the Cassin's kingbird responded to the broadcast surveys.

Threatened, Endangered, and Sensitive Species

A total of 16 listed or candidate species were identified by the NNHP as occurring, or potentially occurring, on or near the LOMCRAs (Table 3). In addition to listed species, migratory birds and non-endangered raptors and bald eagle may occur on or near the LOMCRAs. Migratory birds and non-endangered raptors are treated in the section above.

Table 3. Species with potential to occur on or near the LOMCRAs.

Scientific Name	Common Name	NESL Status*	Federal Status
Empidonax trailii extimus	Southwestern willow flycatcher	Group 2	E, MBTA
Mustela nigripes	Black-footed ferret	Group 2	E
Rana pipiens	Northern leopard frog	Group 2	none
Aquila chrysaetos	Golden eagle	Group 3	EPA, MBTA
Buteo regalis	Ferruginous hawk	Group 3	MBTA
Strix occidentalis lucida	Mexican spotted owl	Group 3	T
Accipiter gentilis	Northern goshawk	Group 4	MBTA
Aegolius acadicus	Northern saw-whet owl	Group 4	MBTA
Charadrius montanus	Mountain plover	Group 4	T, MBTA
Falco peregrinus	Peregrine falcon	Group 4	MBTA
Glaucidium gnoma	Northern pygmy owl	Group 4	MBTA
Microtus mexicanus navaho	Navajo Mountain vole	Group 4	none
Otus flammeolus	Flammulated owl	Group 4	MBTA
Plecotus townsendii	Townsend's big-eared bat	Group 4	none
Vulpes macrotis	Kit fox	Group 4	none
Haliaeetus leucocephalus	Bald eagle	none (ETL)	EPA, MBTA

** NESL March 2001 List*

Status Definitions

Navajo Endangered Species List Status Codes and Definitions

G1- Group 1: Extirpated - Species no longer occurs on the Navajo Nation.

G2- Group 2: Endangered - Any species or subspecies in danger of being eliminated from all or a significant portion of its range on the Navajo Nation.

G3- Group 3: Threatened - Any species or subspecies which is likely to become endangered within the foreseeable future, throughout all or a significant portion of its range on the Navajo Nation.

G4- Group 4: Candidate - Any species or subspecies for which the NFWD does not currently have sufficient information to support their listing as G2 or G3 but has reason to consider them. The NFWD is actively seeking information to determine if they warrant inclusion in a different group or removal from the list. They are not protected under Tribal Code but should be considered in project planning.

ETL – A species for which element occurrence records are requested, but have no listing status on the NESL.

Federal Status Codes and Definitions

LE - Listed Endangered by the USFWS under the Endangered Species Act (ESA).

LT - Listed Threatened by the USFWS under the ESA.

C -Candidate as listed by the USFWS under the ESA. Species determined to be appropriate for listing, but are currently precluded due to other listing priorities.

MBTA – Birds federally protected under the Migratory Bird Treaty Act (16 USC § 703 et seq).

EPA – Bald and Golden Eagle Protection Act of 1940 (16 USC § 668a-668d)

Species that have no potentially suitable habitat on the LOMCRAs were not included on this list of TES species. Such species included all fish species, riparian obligates, species with particularly narrow geographic distributions, and species with specific habitats not found on or near the LOMCRAs. Fish species and riparian obligates (i.e. western yellow-billed cuckoo) were not considered as there are no such habitats on the LOMCRAs. The following section provides a brief summary of each listed species considered by this biological report. The species status, habitat requirements, and potential to occur on the LOMCRAs are described. Details of the extent of suitable habitat for species potentially occurring on the LOMCRAs is also described.

Listed Species Descriptions

Southwestern Willow Flycatcher (*Empidonax trailii extimus*)

The southwestern willow flycatcher is a riparian obligate, neotropical migrant subspecies that nests along rivers, streams, or other wetlands where dense growths of shrubs and medium-sized trees are present, often with a scattered overstory of cottonwood. It is known to nest in thickets dominated by salt cedar (Sogge et al. 1997). In the Southwest, nesting habitat usually contains or is adjacent to water or saturated soil (Phillips et al. 1964, Muiznieks et al. 1994). Foraging habitat is typically riparian habitats, backwaters, and sandbars adjacent to nest sites (Sogge et al. 1997). The southwestern willow flycatcher was listed by the USFWS as an endangered species in February 1995 (60 FR 10694) and is currently listed as a Group 2 NESL species on the Navajo Nation (NNHP 2001).

Observations of willow flycatchers (*E. trailii*) have been recorded in the lower valleys throughout the region (La Rue 1994), but the subspecies of willow flycatcher observed has never been documented. Since there are at least three subspecies of willow flycatcher that could be present in the area during migration, it is impossible to determine the subspecies observed using visual characteristics. All drainage stringers that support salt cedar may be considered habitat. The J2/15 LOMCRA has such a habitat that bisects the area and the portion of Yellow Water Wash that borders the N9 North area also supports this habitat. None of the LOMCRAs have suitable breeding habitat however and any records of this species on LOMCRAs will undoubtedly be migrants.

Black-footed ferret (*Mustela nigripes*)

The black footed-ferret is listed as a Group 2 NESL species by the NFWD and is currently considered extirpated from the Navajo Nation. This species was listed as an endangered species by the USFWS on 11 March 1967 (32 FR 4001). The historic range of this ferret extends from the Great Plains of Canada to the inter-mountain region of the interior Rocky Mountains and the Southwest. In Arizona, the black-footed ferret's range probably coincided with that of Gunnison's prairie dog (*Cynomys gunnisoni*), from western Coconino County eastward, north of the Mogollon Rim, and possibly ranging south of the rim with black-tailed prairie dog *(Cynomys ludovicianus*) colonies in Graham and Cochise counties (Hoffmeister 1986). While no naturally occurring wild populations are known today, the ferret has been reintroduced successfully in northwestern Arizona and Wyoming. It has traditionally lived in prairies, almost exclusively in association with prairie dog towns as prairie dogs are the ferret's primary source of food. In addition, old prairie dog burrows are used by black-footed ferrets for denning, breeding, and raising their young (USFWS 1978). There are no known records of this species on Black Mesa and this species will not be affected by ground disturbance activities.

Northern Leopard Frog (*Rana pipiens*)
Northern leopard frogs are found in a variety of habitats including, grassland, brushland, woodland, and forest, ranging from near sea level to high elevation mountain areas. Areas where this species is found are normally lacking bullfrogs (*Rana catesbiana*) and introduced fish (Hayes and Jennings 1986, Rosen et al. 1996). It may forage at a distance from water in damp meadows. This species is fairly resistant to disturbance as long as adequate buffers are kept around water sources where this species is found. At present nearly all of the known populations of this Group 2 NESL species are now considered extirpated on the Navajo Nation (personal communication, David Mikesic, NFWD, August 2003). Currently, there are no suitable habitats for this species on Black Mesa, and there are no known documented historic records for the northern leopard frog on Black Mesa. Although the many water impoundements that now occur on the leasehold and on areas adjacent to the leasehold, could potentially support this species, there is no natural method for introduction of leopard frogs onto the Black Mesa monocline.

Golden Eagle (*Aquila chrysaetos*)
The golden eagle, a Group 3 NESL species, is a large raptor that is found throughout North America, most frequently in open areas, especially where large, steep cliffs or tall, coniferous trees are present, providing nesting locations at the edges of foraging territories. Most nesting areas are perennial and are occupied by the same breeding pair for many years (Ehrlich et al. 1988). In most of the West, adults remain on territories throughout the year; Black Mesa is no exception to this rule. Golden eagles typically prey upon small to medium sized vertebrate prey including rabbits, snakes, and ground squirrels. Golden eagles have been near Lolomi Point, and near Kayenta Point. Golden eagles are sparse permanent residents of Black Mesa and there is evidence that this species occasionally occurs on the leasehold to forage on prairie dog towns on the southern end of the mine leasehold. Specific records for this species on the leasehold are not available.

Ferruginous Hawk (*Buteo regalis*)
The ferruginous hawk, a Group 3 NESL species, is a large raptor that is closely related to the red-tailed hawk (*Buteo jamaicensis*). It is the largest *Buteo* hawk in North America and is found breeding in open country from the Great Plains to southern California, Nevada, and eastern Washington and Oregon with sporadic records east of the Great Plains (Sibley 2000). Ferruginous hawks use perennial nest sites located in trees, on cliff faces, or on the ground. Prey includes small mammals and other small vertebrates and population fluctuations appear to be closely tied to jackrabbit abundance. On the Navajo Nation, nesting sites are known from juniper (*Juniperus* sp.) trees and transmission lines, but are associated with areas where preferred prey, jackrabbits (*Lepus californicus*) and cottontail (*Sylvilagus* spp.) occur. Ferruginous hawks are migratory and winter in the southwestern U.S. and Mexico.

On Black Mesa, ferruginous hawks have been observed both on and off the leasehold. On the Navajo Nation, nesting sites are known predominantly (~90%) from short cliffs, badland bluffs and pinnacles, or erect sandstone structures. Similar types of habitats occur on the LOMCRAs, but there are no records for this species breeding on Black Mesa. One summer record of an adult dark morph suggests that breeding may have occurred on or near Black Mesa since mining began (LaRue 1994). The lagomorph community and the large prairie dog colonies may attract this species during the fall and spring months when migrants are common throughout Arizona, but the potential for breeding pairs to establish on the leasehold is low.

Mexican spotted owl (*Strix occidentalis lucida*)

The Mexican spotted owl is listed as a Group 3 species on the NESL and is listed as threatened by the USFWS (58 FR 14248). The Mexican spotted owl has a wide but patchy distribution throughout Arizona (except for the southwestern portion of the state where it is absent). Throughout the majority of the state this species inhabits rocky canyon lands and coniferous forests. Ganey and Balda (1989) found this species only in forested highlands, at elevations ranging from 3,690 to 12,100 feet. Suitable habitat is generally described as having relatively closed canopy made up of ponderosa pine, mixed conifer forest, and associated with steep canyons (AGFD 1988; Ganey and Balda 1994). Nests are typically in trees, on platforms such as old squirrel nests or other raptor nests, in tree cavities formed by broken off branches or tops of witches brooms, or in rock cavities or caves. The diet of the spotted owl can be varied, consisting of small mammals, birds, lizards, bats, beetles, and rabbits, although woodrats (*Neotoma* sp.) are the most common and important prey item range wide (Ganey and Balda 1985, Johnson and Johnson 1985). Foraging typically takes place at night.

Mexican spotted owls have been studied extensively on Black Mesa, where this species is a permanent resident. Intensive monitoring was conducted from 1994 to 2000 and results are presented in PWCC annual wildlife monitoring reports and Chapter 10, Fish and Wildlife Resources, in the PAP. Mining activities on the northern edge of the leasehold initiated surveys and additional studies, and formal monitoring and other studies were ongoing between 1982 and 2000. All nesting records for this species have been in mixed conifer habitats, many within two miles of the leasehold's northern boundary. The LOMCRAs that are closest to potentially active Mexican spotted owl breeding locations are the N9, N10 and N99 North LOMCRAs. There are no suitable breeding habitats within any of the LOMCRAs, but movements of this species are unknown during winter periods. To date, there has been no evidence that Mexican spotted owls use mine reclamation or adjacent undisturbed pinyon-juniper habitats on the leasehold. The closest known records of Mexican spotted owl to the Black Mesa leasehold have been monitored in Yellow Water Canyon and in side canyons of Coal Mine Wash and Moenkopi Wash.

Northern Goshawk (*Accipiter gentilis*)

Northern goshawks nest in large forest stands characterized by a canopy cover greater than 50% and sparse understory vegetation (Johnsgard 1990). The northern goshawk is a Group 4 NESL species. In the Southwest, goshawks are most frequently found in pine forests with open park-like understories. Stands of old growth trees are preferred for nest sites but the species has been known to nest in young second growth forest, as long as older trees remain in the stand. Nest height is typically between 60 and 140 feet, but most studies of nesting northern goshawks have been conducted in stands of tall timber (i.e. ponderosa pine (*Pinus ponderosa*), or Douglas fir

(*Pseudotsuga menseizii*)(Siders and Kennedy 1994).

Northern goshawk habitat consists of three critical elements (Reynolds et al. 1992). The first is a nesting area of approximately 30 acres containing one or more stands of large, old trees with a dense canopy cover. The nesting area should contain three suitable nesting sites, with three additional alternative nesting sites. Nesting sites are typically located in northerly aspect drainages or canyons near a source of water. The second habitat element is a Post Fledgling Area (PFA) of approximately 420 acres surrounding the nesting area. This area is important for fledged nestlings to hunt and hide from predators. The PFA must contain a variety of forest types and conditions including patches of dense trees, a developed herbaceous and/or shrubby understory, and prey habitat attributes such as snags, downed logs, small forest openings ($^1/_3$ to 4 acres), and woody debris. The majority of the PFA is forest of mid-aged, mature, or old trees with an intermixture of forest vegetative stages, supporting prey species including squirrels, rabbits, woodpeckers, jays, and grouse. The third element of goshawk habitat is a foraging area of approximately 5,400 acres. The foraging area must contain similar attributes as the PFA, however a more open canopy is suitable without the need for fledgling protection.

LaRue (1994) reported one nesting record for northern goshawk on Black Mesa nesting in a dense pinyon-juniper stand in White House Valley during the breeding season of 1993. Recent historic records also suggest that northern goshawks are more abundant during the winter month, especially during some years (LaRue 1994). Most of the nesting records are from mixed conifer habitats and large stands of ponderosa pine, north of the leasehold. An aggressive female was observed during the 2001 field season approximately 2 miles north of the leasehold in Yellow Water Canyon. Potentially suitable breeding habitat on LOMCRAs exists in the N99 North, N10, and N9 LOMCRAs.

Northern Saw-whet Owl (*Aeoglius acadicus*)

The northern saw-whet owl, a Group 4 NESL species, is a small migratory raptor that inhabits ponderosa pine, pine-oak, and mixed conifer woodlands of the western U.S. (Ehrlich et al 1988). This species nests in abandoned woodpecker holes or natural cavities and forages mainly on rodents. The northern saw-whet owl is listed as a Group 4 species on the NESL, mainly due to a poor understanding of the species distribution on the Navajo Nation (Mikesic and Nystedt 2001). Although this species probably breeds on Black Mesa, there are no current records of breeding (La Rue 1994). This species has been observed and heard numerous times in the vicinity of Owl Canyon (west of road to Kayenta Point) and other locations on the northern edge of Black Mesa, but no records are known from the mine leasehold. All locations where this species has been identified are characterized by well-developed forest habitat including ponderosa pine and Douglas fir or well-developed pinyon pine woodland adjacent to mixed conifer woodland. The habitats represented within the LOMCRAs do not provide suitable nesting habitat for this species and it is unlikely that the species would occur on any of the LOMCRAs.

Mountain Plover (*Charadrius montanus*)
The mountain plover is a migratory shorebird, similar in size to the killdeer (*Charadrius vociferus*), but lacking the bold markings on the neck and around the eye (Sibley 2000). This species is typically found far from water, where it breeds in shortgrass prairie, rolling grasslands, and badlands frequently with more than 33% bare ground (Ehrlich et al. 1988). This species breeding range extends from Montana, Wyoming, and eastern Colorado, to New Mexico, and the Oklahoma, and Texas panhandles. Wintering areas are typically southern Arizona, New Mexico, Texas, California, and northern Mexico. Migration habitat is similar to breeding habitat. In some areas this species is found preferentially near prairie dog (*Cynomys* sp.) and bannertail kangaroo rat (*Dipodomys spectabillis*) colonies. This species is listed as a Group 4 species on the NESL and has been proposed for listing as a threatened species by the USFWS (68 FR 8487).

The only known breeding records for this species that have been documented in northwestern New Mexico, occur on the Navajo Nation, where 11 plovers were recently found breeding in badland habitats with low vegetative cover (USFWS 2002; 67 FR 72396). Vegetative coverage suggests that the LOMCRAs on the southwestern end of the leasehold should be considered suitable breeding habitat so there is potential for this species to occur on the project area. The presence of large colonies of prairie dogs on the J5/6/13/14 and J8 LOMCRAs, and the low vegetative cover produce potential breeding habitat for this species. There are no records of this species on Black Mesa.

Mountain plovers generally leave breeding areas shortly after breeding is completed and post-breeding movements are well underway by August (64 FR 7587). Recent precipitous, range-wide declines in the populations of this species have prompted the USFWS to reopen the comment period for the listing of the mountain plover.

Peregrine Falcon (*Falco peregrinus*)
The peregrine falcon was originally listed as endangered on 2 June 1970 (35 FR 8591) after precipitous declines in populations, attributed to effects from pesticide use. After successful recovery, the peregrine falcon was removed from the USFWS list of endangered species on 25 August 1999 (64 FR 46541); it remains a Group 4 species on the NESL. Peregrine falcons are found throughout the U.S. and, on the Navajo Nation, are found where steep-walled canyons and cliff habitats occur. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Johnson et al. (1977) found some of the highest breeding bird densities in North America in southwestern riparian habitats. Nests are sometimes found on man-made structures such as building ledges and bridges (usually as a result of hacking programs). The density of cliffs may determine the suitability of an area for nesting.

On the Navajo Nation, peregrine falcons have been known to nest on cliffs of 150 feet high or less, but usually breed on tall, extensive cliffs, 300 feet in height or greater. The best peregrine nesting habitat on the Navajo Nation occurs in the canyons and cliffs on the forest edge. Such areas include Canyon de Chelly and the sandstone cliffs near Navajo, New Mexico, where falcons are known to nest regularly.

Suitable nesting habitat occurs on the northern edge of Black Mesa and in the steep-walled canyons on the northern portion of Black Mesa. Several historic nesting sites were monitored annually by PWCC until the 2001 field season. Several permanent ponds are used as foraging habitat by peregrine falcons that breed on the northern rim. Historic records collected by PWCC have documented peregrine falcons preying upon horned larks (*Eremophila alpestris*) on mine reclamation, Baird's sandpipers (*Calidris bairdii*) over N2 reclamation, and mourning dove (*Zenaida macroura*) in Long House Valley. Peregrine falcons have been observed during annual monitoring hunting waterfowl on the J7 pond, the N14 ponds, and the N1-RA basin of the N1-2 reclamation. Observations documented during PWCC annual monitoring have occurred between March and September.

None of the LOMCRAs provide suitable nesting habitat for peregrine falcons, but all areas that support adequate numbers of birds may be potentially suitable foraging habitat. Such LOMCRAs include the N9, N10, N99 North, and N12/N99 South LOMCRAs. These areas all have well-developed pinyon-juniper woodland where prey species (especially jays and mourning doves) are found.

Northern Pygmy Owl (*Glaucidium gnoma*)

The northern pygmy owl is found throughout the forested portions of the western U.S. (Ehrlich et al. 1988). This species is listed as a Group 4 species on the NESL and breeding records of this species on the Navajo Nation are sought by the NFWD. Breeding records for this species are known from the Chuska Mountain range and Tsegi Canyon (Mikesic and Nystedt 2001). This species typically occupies dense coniferous or deciduous woodland habitats and on Black Mesa is known from mixed conifer habitats (LaRue 1994) in Coal Mine Wash and Yellow Water Canyon areas. There are no records for this species within the 2-mile Black Mesa buffer zone.

No mixed conifer habitat occurs on the LOMCRAs and it is unlikely that this species would be found within any of the LOMCRAs. This species is suspected to move to lower elevations during the winter months and since records of this species are known from Yellow Water Canyon, an area adjacent to the N9 LOMCRA, some portions of the northern LOMCRAs may be used during winter. Mining in these areas will not affect this species.

Navajo Mountain Mexican Vole (*Microtus mexicanus navaho*)

The Navajo Mountain vole is one of three recognized subspecies of Mexican vole found in Arizona (Hoffmeister 1986). This species is listed as a Group 4 species on the NESL. Compared to the other two subspecies, *Microtus mexicanus mogollonensis* and *M. m. hualapaiensis*, this subspecies is characterized by smaller size in all external and most cranial measurements, and by having a lighter dorsal coloration. Navajo Mountain Mexican voles (hereafter Mexican vole) were originally identified on Navajo Mountain, on the Arizona-Utah border, but have also been documented in other areas of Arizona. Other areas include south of the Grand Canyon, on the San Francisco Peaks, near Williams, and on the sky islands of the Navajo Nation, including Black Mesa.

Mexican voles are typically inhabitants of dry, grassy areas and are the most widely distributed Microtine rodent in Arizona (Hoffmeister 1986). These animals have been trapped in all life zones from pinyon-juniper to spruce-fir. Where they are found, they can occur in high densities

and have been captured in close proximity to other *Microtus* species. Mexican voles have relatively low reproduction rates with litters averaging two embryos (Hoffmeister 1986). Reproductively active individuals have been found to be pregnant in all months of the year,.but reproduction is generally limited to periods of snow absence (Hilton 1992).

On Black Mesa, previous baseline studies of the leasehold describe this species as rare in abundance, and found in areas of rocky substrates (LaRue 1994). Mexican voles have also been trapped in continuous stands of sagebrush, near permanent impoundments on mine reclamation, and along drainage bottoms (LaRue et al. 1994, Marshall 1999). Where this species occurs, it may be numerous. During the 1999 field season, live trapping was conducted in closed basins within mine reclamation, and on mine reclamation grasslands (Marshall 1999). Over 2,940 trap nights, a total of 28 Mexican voles were captured in closed reclaimed basins and no Mexican voles were captured on reclamation grassland. The number of Mexican voles captured represented 21% of the total number of rodents captured during the study. The presence of this species near water impoundments suggests an affinity for more mesic habitats that support a higher abundance of herbaceous ground cover with a taller mean vegetation height.

Habitat, in the form of contiguous sagebrush stands (Attachment B, Photo 3), and drainage stringers with salt cedar, is present for this species in the N10, N99 North, and the J2/15 LOMCRAs. The total acreage of suitable habitat in each of these LOMCRAs is 40.8, 27.8, and 1.6 acres respectively for a total of 70.2 acres across all LOMCRA study areas. An extensive amount of time was spent searching suitable habitat within these LOMCRAs to identify potentially occupied habitat. Runways were found in the J2/15 LOMCRA, within the narrow drainage that bisects the two LOMCRAs (Photo 4). This set of runways appeared to be active, but no trapping was conducted to ascertain the presence of this species. The past three years have been characterized by unusually low rainfall throughout the Southwest and rodent populations appear to be at an extreme low (personal observation). Certain populations of Microtine rodents with less favorable habitat conditions may become extirpated during these periods of environmental harshness, so the status of such populations in future years should be monitored accordingly.

Flammulated Owl (*Otus flammeolus*)

The flammulated owl is listed as a Group 4 species on the NESL, and is protected federally under the MBTA. This small owl primarily forages on insects, preferably in mature stands of pine forests and upper oak woodlands. Flammulated owls nest in tree cavities and can be found in any ponderosa pine, oak, and mixed-conifer stands where sufficient cavities are present (Lesh et al. 1994; McCallum et al. 1995). Nests are built in abandoned woodpecker holes, especially those of flickers. On Black Mesa, this species is known from numerous areas north of the mine leasehold, especially where stands of ponderosa pine (*Pinus ponderosa*) or Douglas fir (*Pseudotsuga menzeizii*) are found in close proximity to pinyon-juniper woodland (LaRue 1994). This species has been identified just north of the Black Mesa leasehold boundary in Yellow Water Canyon, where a male was heard calling regularly between the 1997-2000 field seasons. Although suitable habitat can be found within two miles of the mine leasehold, there is no suitable habitat on the proposed LOMCRAs.

Townsend's Big-eared Bat (*Plecotus townsendii*)
The Townsend's big-eared bat is listed as a Group 4 species on the NESL, but has no federal listing status. In Arizona, this bat is widespread, although not apparently common anywhere within its range. While they can be found in a variety of habitat types, including arid desert scrub, pinyon-juniper, and ponderosa pine habitats, they prefer to forage in riparian areas and forest edges. They feed primarily on moths, but will also feed upon other insects including lacewings and beetles (Sample and Whitmore 1993). Townsend' s big-eared bats inhabit mines, caves, and large crevices during the day, and often rest in abandoned buildings at night (Hoffmeister 1986). These bats are also found near open water. During the summer, females congregate in caves to form maternity colonies

This species has not been documented during field studies on Black Mesa, but is suspected to occur on Black Mesa (Hoffmeister 1986). Habitat on the LOMCRAs includes dry drainage basins and small openings within the pinyon-juniper woodland. Roost sites occur on some of the LOMCRAs where cliff faces or sandstone bluffs occur. These areas may provide adequate day roosts and hibernacula. Given the presence of similar and more suitable habitats throughout northern Black Mesa off the leasehold, ground disturbance activities on the LOMCRAs are not expected to affect this species.

Kit Fox (*Vulpes macrotis*)
The kit fox is the smallest of North American canids and can be found inhabiting the bleak deserts of the western U.S. (MacDonald 1995). This species is identified by unusually large, buff-colored, ears, black tail tip, and a uniform colored body (Hoffmeister 1986). Dens having a characteristic key-shaped opening are excavated in desertscrub and badland habitats characterized by softer soils. Vegetative associates include saltbush, sagebrush, and black greasewood (*Sarcobatus vermiculatus*)(Mikesic and Nystedt 2001).

The San Joaquin kit fox (*Vulpes macrotis mutica*) was listed as endangered by the USFWS on 11 March 1967 (32 FR 4001). The subspecies of kit fox known from the Navajo Nation (*V. macrotis macrotis*) is listed as a Group 4 species on the NESL, but has no current federal status. Kit fox are known on the Navajo Nation from the eastern side of the Chuska Mountains and in the Chinle Valley in Arizona and Utah. Potential habitat exists throughout the Navajo Nation and the habitat found on some of the LOMCRAs is suitable for this species. Such habitats would include the large areas of greasewood, sagebrush, and saltbush on some of the southern LOMCRAs including J8, J2/15, J5/6/13/14, and J23.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle, a Group 4 NESL species, is distributed from Alaska and northern Canada to north central Mexico. Bald eagles primarily eat fish, but are also know to eat other small vertebrates and carrion. Winter diets for bald eagles can vary depending upon location and food sources, but wintering eagles generally depend on waterfowl and carrion and less upon fish (Busch 1986). Bald eagle breeding habitat is characterized by large trees, suitable for nesting, with a nearby water source that provides an adequate supply of moderate-to-large size fish (Johnsguard 1990). Breeding habitat for bald eagles in the Southwest is almost exclusively tied to water sources (Hunt et al. 1992). Bald eagles winter throughout much of the southern United States. Wintering habitats for bald eagles are less closely associated with water than summer habitats (Evans 1982). Roost sites important to bald eagles are usually in fairly open stands with trees that are taller than surrounding canopy (Stalmaster and Newman 1978, Keister and Anthony 1983).

Habitats of the LOMCRAs should generally be considered unsuitable foraging or breeding habitats for bald eagles. Foraging exceptions would be carrion (in the form of dead cattle or sheep), or terrestrial mammals, which may present foraging opportunities for migrating bald eagles. Pinnacles or other tall perching areas near ponds including the J-7 pond, Wild Ram tank, and N14-D ponds may be useful for migrating bald eagles due to the presence of fish, but these areas would only be used temporarily. Bald eagles have been observed in Coal Mine Wash, Moenkopi Wash, Dinnebito Wash, and lower Yellow Water Canyon. Two adults were also observed at the J7 pond in January of 1985 (LaRue 1994) and this species was observed near the haul road, just south of the N1-RA pond during the 1999 field season.

Summary

A total of 7 mammalian, 23 avian, and 5 herpetile species were identified during a general inventory of wildlife on the LOMCRAs. These species have been documented during other wildlife baseline studies and would be expected in similar pinyon-juniper habitats throughout northern Arizona. None of the species observed during baseline studies in 2003 are of special interest, but some avian species (neotropical migrants) are of importance to the NFWD, which request data collection for these species prior to surface disturbance events.

A total of 16 species listed on the NESL were identified as occurring or potentially occurring on or near the LOMCRAs. Species for which potentially suitable habitat is not present on the proposed LOMCRAs were not addressed in this report. Although habitat for the black-footed ferret is present on the J8 and J5/6/13/14 LOMCRAs, it is unlikely that black-footed ferrets occur on Black Mesa. However, PWCC has an approved black-footed ferret monitoring plan (PAP, Chapter 10, Attachment 2) that is ongoing for the Black Mesa leasehold including the LOMCRAs. Ongoing wildlife monitoring activities will determine the extent of prairie dog colonies on an annual basis. Should black-footed ferret surveys be required in the future, PWCC will initiate species-specific spotlighting surveys.

The large prairie dog colonies found on J8 and J5/6/13/14 are potentially suitable breeding habitats for the mountain plover. Reduction in vegetation height increases the suitability of a grassland or short shrubland habitat to support the mountain plover (Ehrlich et al. 1988, USFWS, 68 FR 8487). Although this habitat is present, it is unlikely that this species occurs on the Black Mesa leasehold. Should this species be identified on any of the suitable LOMCRAs, surveys and monitoring would be necessary to determine impacts of mining on this species. Numerous locations found on mine reclamation where ground-level vegetation is short (pre-reclaimed open topsoil or overburden areas) provide suitable habitat for the mountain plover also.

Just as prairie dog colonies provide suitable habitat for mountain plover, they also provide a foraging resource for raptors. Suitable breeding habitat for the ferruginous hawk is found on the southern LOMCRAs where bluffs overlook large expanses of open country (J2/15, J4/5/13/14, and J8). Likewise, these prairie dog colonies provide foraging habitat for the golden eagle, bald eagle (although this species is probably absent during periods of prairie dog activity), and kit fox which may also breed in these areas. No known breeding records for kit fox occur on the leasehold.

Southwestern willow flycatchers may occur in any habitat during migration, but the chances of a known southwestern willow flycatcher occurring in any drainage on or near the proposed LOMCRAs is slim. Although willow flycatchers of undetermined subspecies have been observed on the leasehold, *E. trailii extimus* has never been confidently identified (territorial calling during multiple periods of the breeding season) on the leasehold.

The northern leopard frog has not been documented on Black Mesa and is unlikely to occur on the leasehold. Since there are no wetland habitats found within any of the LOMCRAs, the lack of habitat would exclude the presence of this species, even if an unknown source population occurs on Black Mesa. This species will not be affected by surface disturbance activities associated with mining activities on LOMCRAs.

Some sections of suitable habitat for the Navajo Mountain vole are found within the boundaries of the proposed LOMCRAs. Pedestrian transects were conducted within these strings of habitat and runways were identified within one LOMCRA (Attachment B, Photo 3). Approximately 70.2 acres of Navajo Mountain vole habitat are found on the LOMCRAs.

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ATTACHMENT A

Map 1. LOMCRAs and Potential TES Habitat
Map 2. Northern Goshawk Survey and Raptor Responses

ATTACHMENT B

Photos 1-4. LOMCRA Study Area Photos

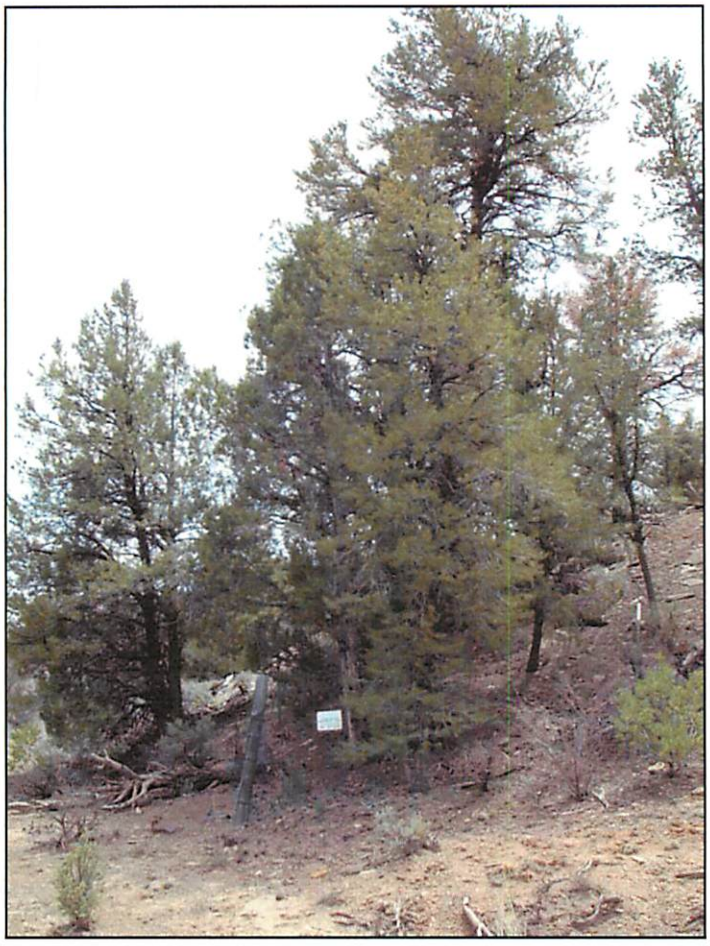

Photo 1. Late seral pinyon-dominated pinyon-juniper woodland. Similar structure is found in N9, N10, N99 North, and N12/N99 South. This patch is a monitoring patch for vegetative monitoring.

Photo 2. Habitats representative of the southern LOMCRAs. Note the reduction in vegetative cover and canopy height of juniper-dominated pinyon-juniper woodland.

Photo 3. Contiguous sagebrush stands in the N10 LOMCRA. Note the shrub density and proximity to pinyon-juniper woodland edge. This photo was taken in a drainage bottom and the habitat is suitable for Navajo Mountain Mexican vole.

Photo 4. Mexican vole runway in a drainage bottom of the J2/15 LOMCRA. The current status of this population is unknown, but appeared inactive.

ATTACHMENT 5

BIOLOGICAL INFORMATION, REFERENCES, AND FUTURE MONITORING EFFORTS FOR THE N9 COAL RESOURCE AREA

BLACK MESA MINING COMPLEX

ATTACHMENT 5

BIOLOGICAL INFORMATION, REFERENCES, AND FUTURE MONITORING EFFORTS

FOR THE N9 COAL RESOURCE AREA, BLACK MESA MINING COMPLEX

The N9 Coal Resource Area was included in the wildlife and habitat reconnaissance for the proposed Life of Mine Coal Resource Areas and the N99 Area of the Black Mesa Mining Complex. This study is included as Attachment 4 to Chapter 10, Fish & Wildlife Resources and the reviewer is directed to that section of Chapter 10.

Peabody and PWCC have conducted annual wildlife monitoring and special studies on the Black Mesa leasehold since the early 1980's. These include, but are not limited to, small mammal studies, passerine and migratory bird observations, raptor monitoring, Mexican spotted owl and peregrine falcon studies, praire dog colony monitoring for black footed ferrets, and special interest species reconnaissance for relevant species included in the NESL and USF&WS T&E lists. The N9 Coal Resource Area will continue to be included in the monitoring activities as will the remainder of the lease area. All annual monitoring information is submitted to the Office of Surface Mining Reclamtion and Enforcement (OSMRE) and the Navajo Nation Fish and Wildlife Department (NNFWD). Confidential information on sensitive or T&E species is submitted to the NNFWD.

These ongoing monitoring studies have increased the status of knowledge for a number of wildlife species in the region. As an example, the 20 years of red tail hawk monitoring data provides one of the most comprehensive population dynamics evaluations for this species in the region. Bird monitoring on the Black Mesa leasehold over the last 25 years has documented approximately 300 species, many of them first records for the region (LaRue, 1994). Intensive monitoring associated with the peregrine falcon and Mexican spotted owl has increased the status of knowledge for these species in the region. A summary of results for these two species is presented in the text and Attachment 2 to Chapter 9, Fish & Wildlife Resources.

Mexican spotted owl (MSO) monitoring was discontinued in 2001 under approval of OSMRE as a result of fulfilling monitoring requirements over a seven-year period. As a result of that monitoring program, no mining related impacts to MSO's were detected. If MSO monitoring is required, it will be initiated prior to and during N9 mining related disturbances occurring within two miles of the nearest mixed conifer habitat identified

on Drawing 85320a. Monitoring locations, timing, and protocols will be coordinated with OSMRE, USF&WS, and the NNFWD.

Annual nesting surveys for raptors will be conducted on areas immediately in advance of and within 0.25 miles adjacent to the active N9 mining area. This is consistent with past efforts in other areas of the Black Mesa Mining Complex and the discussion of Wildlife Resources Protection in Chapter 10. Results will be presented in the annual monitoring report submitted to the regulatory authority.

The N9 area will continue to be included in the overall annual wildlife monitoring effort and particularly the special reconnaissance surveys for potential species found on the NESL and USF&WS T&E lists. The results of all monitoring efforts will continue to be submitted to the regulatory authority on an annual basis.

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