APPENDIX 3

Field Guide to Target Species in the J9 Study Area

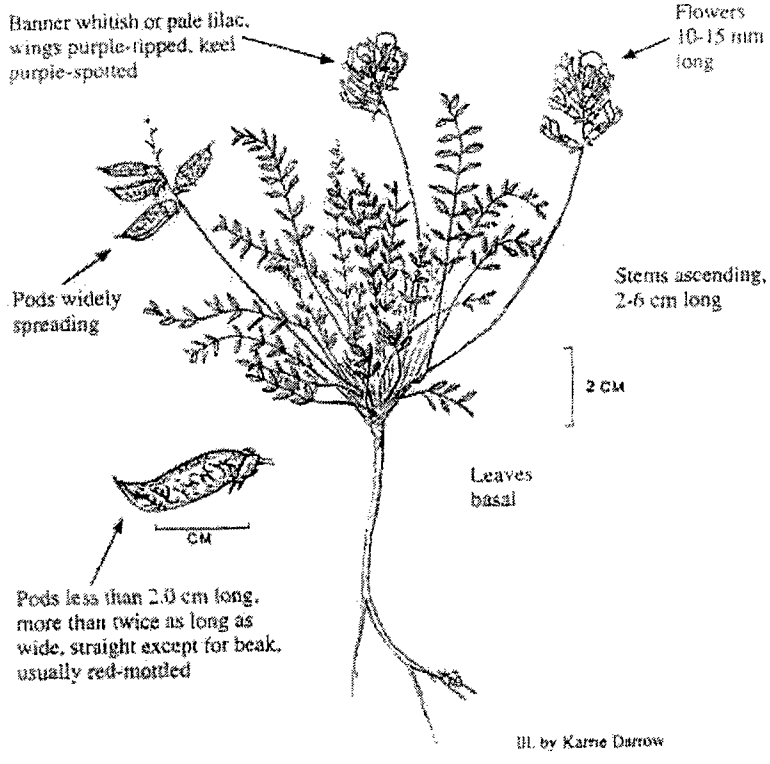
Species: ***Astragalus naturitensis*** Payson
Common Name: Naturita milkvetch
Synonym: *Astragalus arientinus* var. *stipularis*
Status: G4

Distinguishing Characteristics:
-Low growing, minitature spreading perennial about 10 cm tall.
-Leaves basal, pinnate with 9-15 leaflets, leaves 2-7 mm, clustered, obovate to elliptic, mostly folded, often glabrate above, stipules free.
-Peduncles scapose, 2-7 cm, with 4-9 subcapitate or briefly racemose ascending flowers.
-Flowers 10-15 mm long.
-Calyx 4-8 mm, cylindrical, mixed white and black pubescent, lobes 1-1.5 mm.
-Pods leathery, less than 2 cm long, more than twice as long as wide, widely spreading, covered with short, stiff, flat-lying hairs, straight except for beak, usually red-mottled.

Look Alikes: *A. deterior* is distinguished by yellowish white flowers, *A. desperatus* has smaller flowers and loosely hirsute pods of broader and shorter outline, *A. monumentalis* var. *cottamii* has firm-walled, dorsiventrally compressed, unilocular pods, and *A. humillimus* has persistent, spiny rachises.

Flower Color: banner white, keel purple spotted, and wings reddish purple or purple tipped.
Flowering Period: April to early June.
Fruiting Period: late May to June.

Habitat: Sandstone mesas, ledges, crevices and slopes in pinyon-juniper woodlands. 5,000-7,000 feet in elevation. New Mexico, Utah and Colorado.



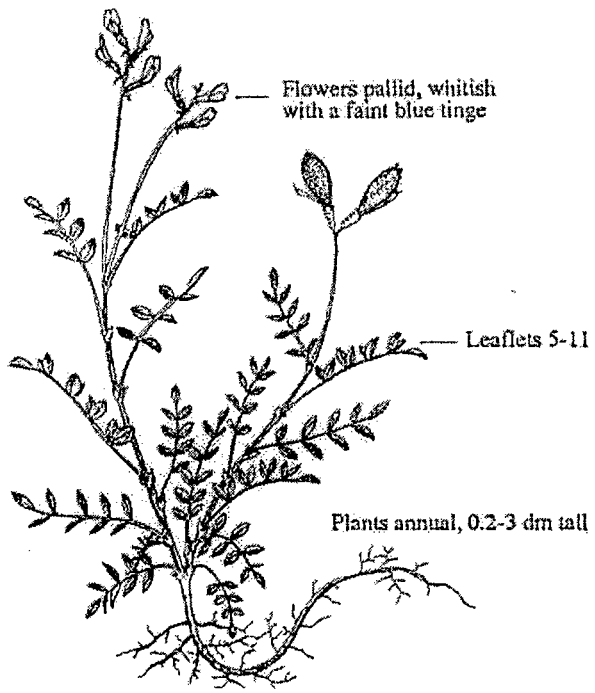
Species: ***Astragalus preussii Gray*** var. ***cutleri*** Barneby
Common Name: Cutler's milkvetch or Copper Canyon milkvetch
Status: G3

Distinguishing Characteristics:
-Ill scented annual.
-Stems 2-11 cm tall.
-5-11 leaflets, 7-12 mm wide.
-Racemes 3-17 flowered.
-Fruit 2-7mm, stipitate.
-Monocarpic.
-Largest 12-20 x 7-12mm.

Look Alikes: Looks like other varieties, but differs in its smaller stature, pallid whitish flowers with faint blue tinge, and fewer leaflets. Other varieties are perennial. When fruiting, can look like *A. praelongus*, but pod has no septum.

Flower Color: pale white with faint blue tinge
Flowering Period: late March to early June

Habitat: Warm desert shrub community. 1,700 to 6,000 ft. Grand County, Utah



1 Racemes 3–17-, in our range not over 11-flowered, the fruiting axis 1–7 (9) cm long; pod stipitate, the stipe (2) 3–7 mm long; Canyonlands and Dixie-Corridor sections of the Colorado Plateau, 1200–1600 m, from Carbon and Grand cos. se. to e. Kane Co., Utah and n. Mohave Co., Ariz.; w. to s. Nev. and se. Calif.
2 Plant perennial, the stems (unless drought-inhibited) 1–4 dm tall; leaflets of longer leaves either 17–23, or if fewer then either shorter or narrower than the next, the longest of a plant 6–15 × 3–6 mm; banner usually vivid purple; range as just given ..... var. *preussii*
2. Plant monocarpic, the stems 2–11 cm tall; leaflets 5–11, the largest of a plant 12–20 × 7–12 mm; petals whitish, faintly blue-tinged; Copper Canyon near mouth of San Juan River, Grand Co., Utah ..... var. *cutleri* Barneby
1 Racemes (except depauperate distal ones) 12–25-flowered, the fruiting axis (4) 6–23 cm long; pod sessile or almost so; rare and local at 650–750 m along the Virgin and Colorado rivers in se. Clark Co. and adj. Mohave Co., Ariz.; to be looked for in the sw. corner of Utah; remotely disjunct on playas in sw. Mojave Desert, Calif. ..... var. *laxiflorus* A. Gray

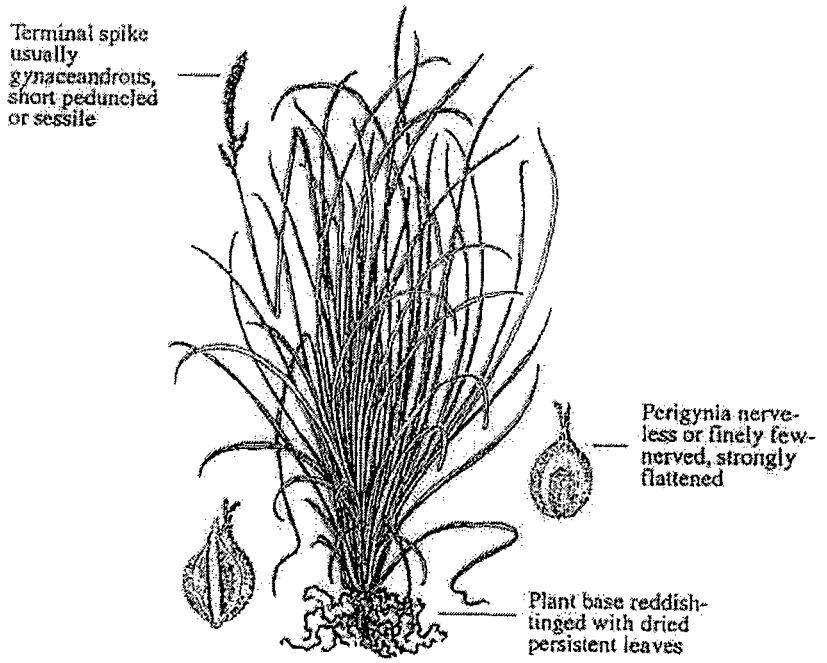
Species: ***Carex specuicola*** J. T. Howell
Common Name: Navajo sedge
Status: Threatened

Distinguishing Characteristics:
-Has both 2-branched styles with lenticular achenes and 3-branched styles with trigonous achenes, but 2-branched style is more common.
-Terminal spike usually gynaceandrous, short peduncled or sessile.
-Perigynia nerveless or finely few-nerved, strongly flattened.
-Plant base reddish tinged with dried persistent leaves.

Look Alikes: There are no *Carex* species that occur with *C. specuicola*.
A *Carex* that resembles it from the Rocky Mountains is *C. atrata*.

Flower Color:
Flowering Period: late June-July

Habitat: Known only from collection near Inscription House, Coconino County, Arizona and San Juan County, Utah. Restricted to Navajo Sandstone seeps-springs, pockets, or hanging gardens, ranging from almost inaccessible sheer cliff faces to accessible alcoves from 5,710-5,980 feet in elevation.



Species: ***Echinocereus triglochidiatus* var. *arizonica*** (Rose) L. Benson
Common Name: Giant Claret-Cup Hedgehog
Status: Endangered

Distinguishing Characteristics:
-Plant cespitose, the few branches or stems grow in clumps.
-Stems are 22.5-40 cm long and 7.5-10 cm in diameter.
-Two to four central spines, 2.5 to 40 cm long, grey or pinkish.
-Eight to ten radial spines, apressed, 0.5-1 cm long, light yellow or pinkish-tan, often slightly curved.
-Stem ribs ± 10, tuberculate.
-Areoles of mature parts of stems with white felt or cobwebby hairs.
-Areoles nearly circular.
-Flowers do not close at night, and stay open for two or three days.
-Flower ± 5 cm in diameter and ± 7 cm long.
-Style 2 mm in diameter.
-Fruit red, fleshy at maturity.

Look Alikes: Similar to other varieties, but is most robust. See variety chart. Other *Echinocereous* species are not red in color.

Flower Color: Red
Flowering Period: May

Habitat: Chapparal and oak woodlands at 3,500 to 4,800ft. Occurs in Arizona in the mountainous area near the line between Gila and Pinal counties.

	A. Var. melanacanthus	B. Var. mojavensis	C. Var. neomexicanus	D. Var. arizonicus	E. Var. gonacanthus	F. Var. triglochidiatus
Stem number	Ultimately numerous, up to 500.	Ultimately numerous, up to 500.	Mostly 5 to 45.	Few.	Few.	Few.
Stem length	1½ to 3 or 6 inches.	1½ to 3 or 6 inches.	8 to 12 inches.	9 inches.	3 to 5 inches.	5 to 12 inches.
Stem diameter	1 to 2 or 2½ inches.	1 to 2 or 2½ inches.	3 to 4 inches.	6 to 10 inches.	2 to 3 inches.	Mostly about 3 inches.
Stem ribs	Mostly 9 or 10, tuberculate.	Mostly 9 or 10, tuberculate.	8-12, mostly 10, not markedly tuberculate.	About 10, tuberculate.	About 8, tuberculate.	5-8, tuberculate.
Spines	Gray, black, pink, or basally tan, or sometimes straw-color, up to 1 to 2½ inches long, nearly straight, rarely angled.	Gray, pink, or at first straw-color, usually up to 1¾ to 2¾ inches long, striate, smooth or angled.	Tan or pink, becoming light gray, up to 1½ inches long, nearly straight, not angled.	Dark gray, up to 1 to 1½ inches long, nearly straight, not angled.	Gray or tan, 1 to 1¾ inches long, nearly straight, 6 or (3-4), 4-angled.	Gray, ¾ to 1 inch long, nearly straight, 3-angled.
Central spines	1-3, light or dark, spreading or the longest deflexed, up to 1/32 inch in basal diameter.	1-2, light, usually twisting, often striate, about 1/32 inch in basal diameter.	2-4, gray, spreading, 1/48 to 1/24 inch or a little more in basal diameter.	1-3, the largest deflexed, acicular, gradually tapering, with minute striations, up to 1/16 inch in basal diameter.	1 (or 0-2), gray, spreading, up to twice as long as the radial, up to 1/20 inch thick, 6-7-angled.	0 (or rarely 1 and then like the radial).
Radial spines	5-11, half as long to sometimes nearly as long as the central.	5-8, half as long to sometimes nearly as long as the central.	9-12, tannish or light gray, about half as long as the central.	5-11, often slightly curved, pinkish-tan, shorter than the central.	6-8, tan or gray, up to 1/24 inch in diameter.	3-6, tan or gray, spreading or recurving, up to 1/16 inch thick.
Flower shape & approximate size	Slender, 1 to 1½ inches in diameter, 1¼ to 2 or 2½ inches long.	Slender, 1½ to 2 inches in diameter, 1½ to 2 inches long.	Slender, 1½ inches in diameter, 2 to 2¾ inches long.	Broad, about 2 inches in diameter, 2½ inches long.	Broad, 2¾ inches in diameter, 2½ inches long.	Broad, 2 inches in diameter, 2 to 2½ inches long.
Style (approximate size)	1/24 inch in diameter, equal to or longer than the perianth.	1/24 inch in diameter, equal to or longer than the perianth.	1/24 inch in diameter, about equal to or longer than the perianth.	1/12 inch in diameter, equal to the perianth.	. .	. .
Geographical distribution	Upland Arizona, Central Utah to southern Colorado and southwestern Texas, Southward in Mexico to Durango.	Northwestern Arizona in Mohave County, Southeastern California; southern Nevada; southwestern corner of Utah.	Southeastern Arizona, Southwestern and south-central New Mexico; Trans-Pecos Texas, Northwestern Mexico.	Arizona between Superior and Globe.	Northern edge of Arizona, Southcentral and southwestern Colorado; northernmost New Mexico.	Near Ft. Defiance, Arizona, Southernmost Colorado; westcentral and central New Mexico.

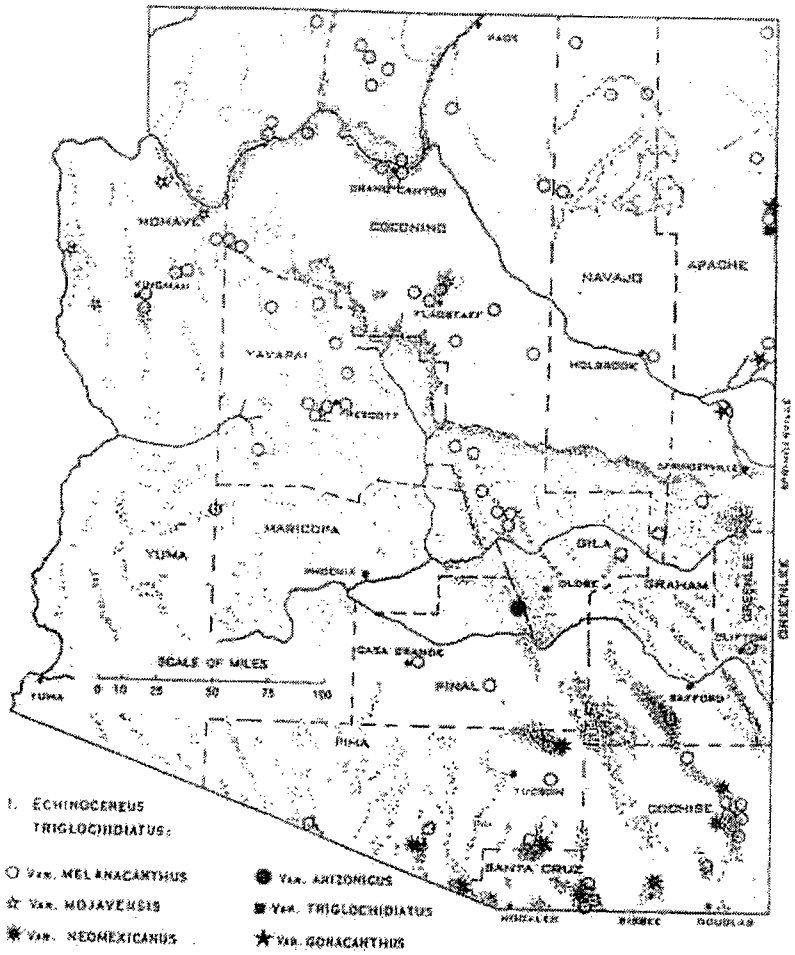


Fig. 3.4. The documented distribution of *Echinocereus triglochidiatus*, according to its varieties.

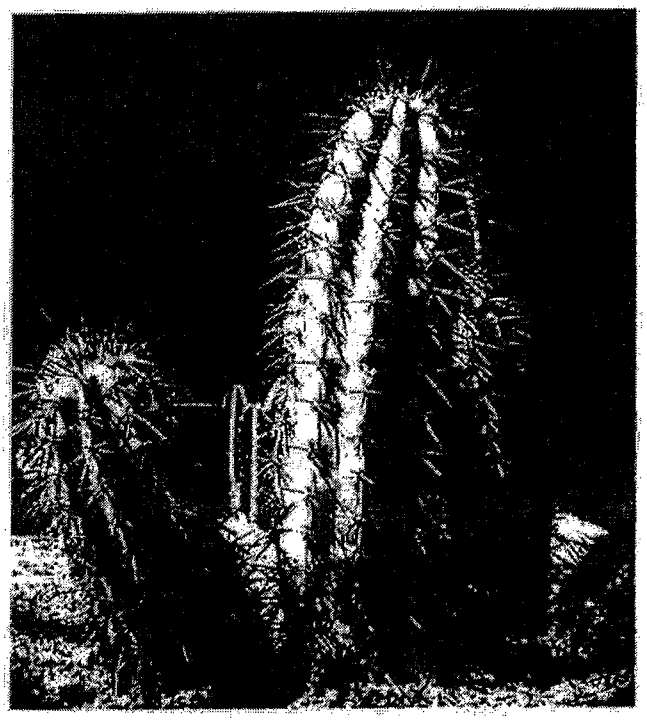


Fig. 654. Red-flowered hedgehog cactus, *Echinocereus triglochidiatus* var. *arizonicus*, plant in cultivation at Sacaton, Pinal Co., Arizona. (Robert H. Peebles)

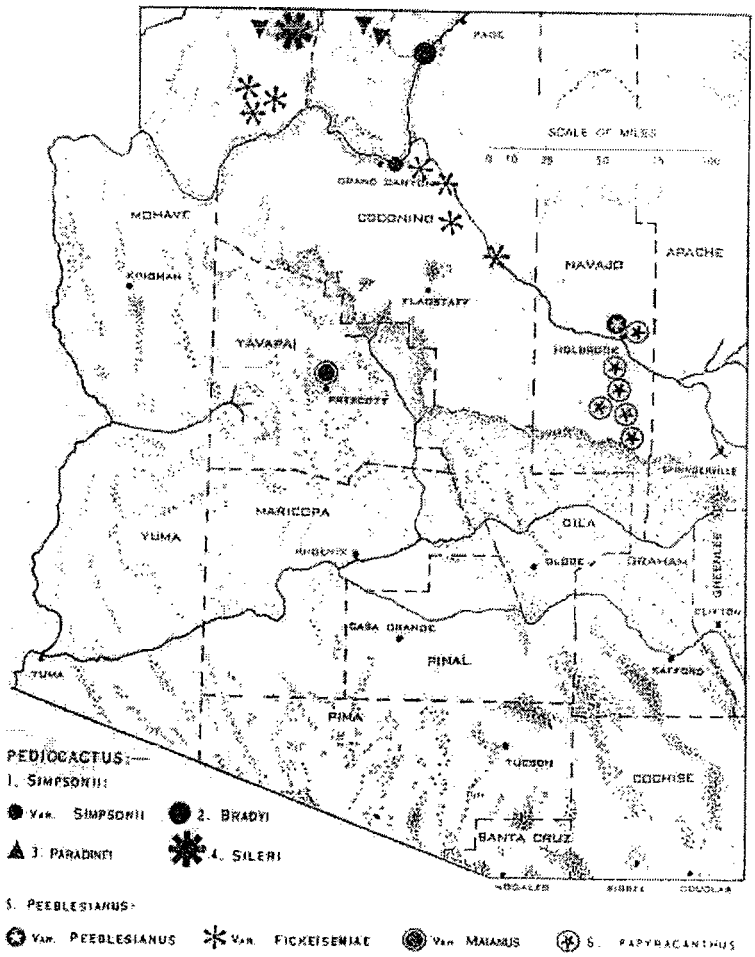


Fig. 8.3. The documented distribution of the Arizona species of *Pediocactus*.

KEY TO THE SPECIES

1. Spines *not* strongly flattened, needlelike, circular to elliptic in cross section; stems globular, depressed-globular, obovoid, or short-cylindroid, their length little greater than their diameter or rarely twice as great.
   2. Surface of the spine smooth, often more or less polished, rarely finely canescent.
      3. Sepaloid perianth parts and the few (if any) scales on the superior floral tube either minutely toothed or short-fimbriate or entire and often undulate; seed black, 1/16 to 1/8 inch long; petaloid perianth parts pink and white, white, magenta, or yellow; areole not more than ⅛ inch in diameter; spines slender, not more than 1/32 inch in diameter.
         4. Central spines none or, if (commonly) present, rigid, gently curving or straight, in mature plants at least distally reddish-brown or reddish, 5/16 to 1/2 or 1 1/16 inches long, 1/72 or 1/48 to 1/32 inch in diameter; petaloid perianth parts marginally either pink or magenta or white with pink middles or wholly yellow.
            5. Central spines present (except in juvenile plants or the lower areoles persisting on adult stems), straight, 5 to 8 or 11 (or in young plants as few as 3) per areole; ovary with a few scales; radial spines almost straight, spreading irregularly, ¼ to ⅜ or ¾ inch long; stems 1 to 5 or 6 inches long, 1 to 4 or 5 inches in diameter; scales of the floral tube toothed or often short-fimbriate; seed about 1/12 inch long; fruit not stalked; seed tessellate-tuberculate.
               1. *Pediocactus Simpsonii*, page 180
            5. Central spines none (or rare); ovary practically lacking scales; radial spines slightly recurved, like the teeth of a comb along the elliptic or elongate areole, ¼ to ¼ inch long; stems at maturity only 1 to 2 or 2½ inches in diameter, often barely protruding above ground; scales of the floral tube minutely toothed; fruit basally constricted into a short stalk; seed papillate and with larger mounds on the surfaces.
               2. *Pediocactus Bradyi*, page 181
         4. Central spines flexible and hairlike, bending or curving irregularly or straight; uniformly colored, white or ashy gray, turning in age to straw- or cream-color, 1 to 1 5/16 inches long, about 1/96 to 1/72 inch in diameter; petaloid perianth parts white or with pink midribs.
            3. *Pediocactus Paradinei*, page 181
      3. Sepaloid perianth parts and the scales of the floral tube long-fimbriate; seed gray, 1/16 to 1/5 inch long; petaloid perianth parts yellow or yellow with maroon veins; areole about ¼ inch in diameter; spines rather stout, 1/32 to 1/24 inch in diameter.
         4. *Pediocactus Sileri*, page 183
   2. Surface of the spine and the tissue beneath spongy-fibrous; sepaloid perianth parts and the scales of the ovary, when present, scarious-margined, never fimbriate.
      5. *Pediocactus Peeblesianus*, page 184
1. Spines strongly flattened, several times broader than thick, puberulent; stems elongate, their length at least twice their diameter.
   6. *Pediocactus papyracanthus*, page 186

Species: ***Pediocactus bradyi*** L. Benson
Common Name: Brady's pincushion cactus
Status: Endangered

Distinguishing Characteristics:
-Stems solitary or rarely two, 3.8-6.2 cm long, 2.5-5 cm in diameter.
-Areoles elliptic, densely white or yellow-villous.
-Spines obscuring stem.
-Flowers borne terminally on or contiguous with spiniferous aeroles.
-Tubricles not grooved.
-Central spines none (2 cases reported 1 or 2 central spines of darker color than radials).
-Radial spines white or tan, 14-15 per areole, glabrous, smooth, tapering gradually from bulbous bases, nearly circular in cross section.
-Flower 1.5 - 3 cm in diameter, 1.5 - 2 cm long.
-Petaloid perianth parts pale straw-yellow, oblanceolate, lower sepaloids green with purplish red midrib, upper sepaloids with green midrib and pale yellow margins.
-Is difficult to see as it blends into rocks.
-May retreat into ground during dry season.

Look Alikes: *Mammalaria spp.* have lateral flowers
Coryphantha spp. have grooved tubricle
other *Pediocactus* spp. have central spines

Flower Color: yellow, fruit green becoming brown
Flowering Period: April

Habitat: Known only from type locality ~4000 ft. in Marble Canyon, Coconino County.

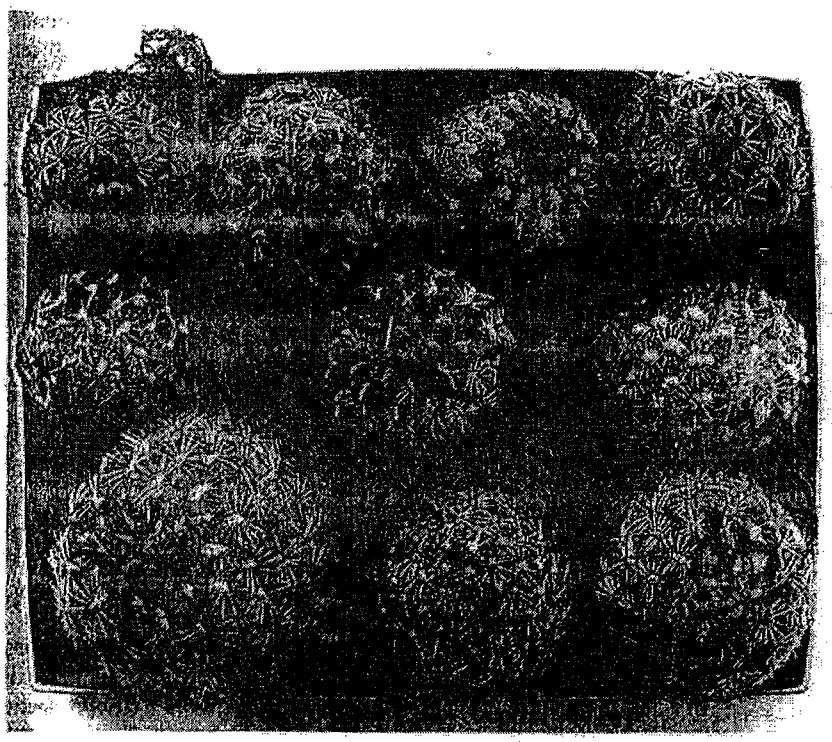


Fig. 793. *Pediocactus bradyi*, plants of the type collection in fruit.

Species: ***Pediocactus peeblesianus* var. *fickeiseniae***
Common Name: Fickeisen plains cactus
Status: G3

Distinguishing Characteristics:
-Stem unbranched or with 2-4 branches, up to 2.5 - 3.8 cm long, 2.5 - 3.8 cm in diameter.
-Highly variable, single, long central spine, ashy white to pale gray, flexible, turned upward.
-6 and occasionally 7 radial spines, straight, spreading irregularly, of varying sizes, 3-6 mm long, 0.25-0.5 mm in diameter.
-Fruit greenish, changing to tan during drying at maturity.

Look Alikes: Other *P. peeblesianus* varieties - see key.

Flower Color: yellow to yellowish-green, sometimes pale or white with a pink or green mid-rib.
Flowering Period:

Habitat: Exposed layers of rock on the margins of canyons or hills in the desert at about 4,000-5,000 feet in elevation. Navajoan Desert and the Great Plains Grassland. Northern Arizona from northeastern Mojave County to the vicinity of the Colorado and Little Colorado Rivers in the Grand Canyon region and southeastward in Coconino County.

TABLE 17. CHARACTERS OF THE VARIETIES OF PEDIOCACTUS PEEBLESIANUS

	A. Var. Fickeiseniae	B. Var. Mafanus	C. Var. Peeblesianus
Relative size	Larger in all parts.	Larger in all parts.	Smaller in all parts.
Stem	Unbranched or with 2 to 4 branches, up to 1 or 1½ or 2½ inches long, 1 to 1½ inches in diameter.	Unbranched, about 2½ inches long, 1½ inches in diameter.	Unbranched, up to 1 inch long, ⅜ to ¾ or 1 inch in diameter.
Central spine	1, erect and prominent (or small or absent in young plants), clearly differentiated from the radials, highly variable.	None.	None; the upper radial spine often longer than the others and up to ¼ or even 5/16 inch long.
Radial spines	Usually 6 but sometimes 7, straight, spreading irregularly, of varying sizes, ⅛ to ¼ inch long, 1/96 to 1/48 inch in diameter.	6, the three lower stout, about ½ inch long, 1/24 inch in diameter, the lowest one curving strongly; the upper as long but more slender, the 2 upper lateral ones much smaller.	Usually 4 but in some areoles sometimes 3 or 5, recurving, with the appearance of a cross, the lower ones usually ⅛ to 3/16 or ¼ inch long, 1/72 to 1/24 inch in diameter.
Geographical distribution	Arizona from northeastern Mohave County to the Grand Canyon region and the vicinity of the Little Colorado River, Coconino County.	Arizona near Prescott, Yavapai County.	Arizona near Joseph City and Holbrook, Navajo County.

Fig. 802 (*above*). *Pediocactus peeblesianus* var. *fickeiseniae*, the type collection, showing the extreme variation in spines to be found in a single population of this variety.

Species: ***Puccinellia parishii*** Hitchc.
Common Name: Parish's alkali grass
Status: G2

Distinguishing Characteristics:
-Annual dwarf grass.
-Culms 10cm, leaf blades flat to slightly involute, up to 1 mm wide; panicle narrow, few flowered, branches strongly ascending.
-Spikelets several flowered; 3-5 mm long.
-Glumes unequal; broad, strongly nerved, scarious margined.
-Palea as long as the lemma or a little shorter.
-Lemmas pubescent on nerves; firm, obtuse; about 2 mm long.

Look Alikes: *P. fasciculata* and *P. airoides*. Both perennial; if hairy, hairs not confined to nerves.
Flower Color:
Flowering Period: June to September

Habitat: Shato, Navajo, Tuba, and Coconino counties. 5,000-6,000ft.
Marshy ground. Usually saline soil.

Attachment 6

2003 Baseline Vegetation Sampling Report
Life of Mine Coal Resource Areas
Black Mesa Mining Complex
(Includes N12/N99 North/South Study Area)

2003 BASELINE
VEGETATION BASELINE SAMPLING REPORT
Life of Mine Coal Resource Areas

Black Mesa Mining Complex

November 2003

Prepared by:

ESCO Associates Inc.
P.O. Box 18775
Boulder, Colorado 80308

And

Peabody Western Coal Company
P.O Box 650
Kayenta, Arizona 86033

TABLE OF CONTENTS

LIST OF APPENDICES

Appendix 1 - Data Tables

Table

Appendix 2 - Plant Species from The LOMCRA Baseline Study, All Areas

Table

LIST OF MAPS

INTRODUCTION

In late May and early June 2003, ESCO Associates conducted a baseline vegetation study of twelve Life of Mine Coal Resource Areas (LOMCRA) within Peabody Western Coal Company's (PWCC) Black Mesa Mining Complex composed of the Black Mesa and Kayenta Mines. The purpose of this sampling was to describe species composition, woody plant density, and diversity in the LOMCRA study areas prior to disturbance by mining. Both quantitative and qualitative data were collected in the LOMCRA study areas; methods, sample areas, and sample sizes were those specified by PWCC.

The vegetation resources in the project areas were similar to those described in previous baseline studies (Peabody Coal Company 1985 and ESCO Associates 2000), consisting of a mosaic of sagebrush and pinyon-juniper vegetation communities. Sampled areas were classified as either sagebrush or pinyon-juniper using aerial photos and previous baseline vegetation maps.

METHODS

Sensitive Plant Surveys

A list of sensitive plant species was compiled from the following sources under the following definitions:

USFWS THREATENED AND ENDANGERED SPECIES (50CFR 17.11 AND 17.12, DEC. 1999)

Endangered species: any species which is in danger of extinction throughout all or a significant portion of its range (other than a species of the Class Insecta as determined by the Secretary to constitute a pest whose protection under the provisions of The Endangered Species Act of 1973 would present an overwhelming and overriding risk to man).

Threatened species: any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as determined by the Secretary.

NAVAJO ENDANGERED SPECIES LIST (NESL)

The following definitions are taken from the Navajo Endangered Species List (NESL) issued by the Navajo Nation Department of Fish and Wildlife-NNDFWL (2001)

Group 1: Those species or subspecies that no longer occur on the Navajo Nation

Group 2 (**G2**) & Group 3 (**G3**): "Endangered" – Any species or subspecies whose prospects of survival or recruitment within the Navajo Nation are in jeopardy or are likely within the forseeable future to become so.

G2: A species or subspecies whose prospects of survival or recruitment are in jeopardy.

G3: A species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future.

Group 4: Any species or subspecies for which the Navajo Nation Department of Fish & Wildlife (NNDFWL) does not currently have sufficient information to support their listing as G2 or G3 but has reason to consider them. The NNDFWL will actively seek information on these species to determine if they warrant inclusion in a different group or removal from the list.

The final sensitive plant species list (Appendix 3 – *Field Guide to Potentially Occurring Rare Plants, Black Mesa Mining Complex*) was organized by species growth habit and habitat preferences, and included detailed descriptions and drawings of morphological traits, mention of lookalikes and distinguishing characteristics, habitat requirements, and phenology. A literature review was conducted on those species listed in the above sources to compile this information (see Kearny and Peebles 1960, McDougall 1973, Arizona Rare Plant Committee 2000, Ecosphere 1995, Great Plains Flora Association 1986, Utah TES Plant Interagency Committee 1991, Spahr 1991, Welsh et al. 1993).

The inner boundary (blue) areas shown on Map 1 were traversed on foot to ascertain the presence of the target species. This pedestrian survey took place between May 20 and June 1, 2003. As of September 2003, the areas to be included in baseline study increased [see outer (red) boundaries]. Inasmuch as the target species were all most reliably to be identified in the early season, the additional areas could not be inventoried for species presence. Rather, they were visited in September and early October 2003 to determine the comparability of habitats of the outer areas to those of the inner areas that were surveyed in detail in the blooming season. This knowledge of the habitats of the outer areas was used to assess the likelihood of the occurrence there of each target species.

Qualitative Data Collection

Twelve LOMCRA study areas were surveyed on the Black Mesa Mining Complex for threatened and endangered species. The areas were J2, J4, J5/6, J8, J10, J13/14, J15, J23, J28, N12/N99 NORTH/SOUTH, N9, and N10. The vegetation type in J5/6 was entirely sagebrush whereas the vegetation in N9 and N10 was entirely pinyon-juniper. All other areas comprised a variable mosaic of both vegetation types.

Using maps provided by PWCC and plotted over a photographic base with Universal Transverse Mercator (UTM) waypoints marking the boundaries, ESCO personnel walked throughout these areas searching for the listed species' habitat requirements. If habitat was found, a more detailed search of the area was performed. During the course of this survey, 'lookalike' species were noted as were 'cultural' species (those of significance to the Navajo and Hopi). Occasionally these specimens were entered into a handheld Global Positioning Device (GPS) for potential seed collecting or salvage purposes. If any species of concern were encountered these would also have been mapped using the GPS and located on the maps provided by PWCC.

Quantitative Vegetation Sampling

Quantitative data were collected for cover and woody plant density in all areas surveyed for threatened and endangered species (discussed above) except J23 which had previously been quantitatively sampled (Peabody Coal Company 1985). A map with randomly generated sampling points (Map 1) overlaying a photographic base was provided by PWCC for each of the baseline areas to be sampled. This information is included on Map 1. UTM coordinates were also provided for each point which in

conjunction with the use of hand-held GPS units, assisted in objective sample point location.

COVER SAMPLING

Cover data were collected along randomly oriented 50 m transects using a point-intercept method in which data were recorded as interceptions of a point with a plant species, litter, standing dead plant material, bare soil, or rock. Plant material produced during 2003 and still standing was tallied by species. Litter was considered to be any organic material that had fallen, or begun to fall to the soil surface. Standing dead was any dead plant material that was produced in previous years but which was still standing and had not lodged or broken off to become litter. Inorganic materials greater than 1 cm in diameter were considered rock. The cover sampling points were optically projected using a Cover-Point Optical Point Projection Device developed by ESCO Associates. One hundred points were collected at each transect. The points were evenly distributed; a pair of points collected on opposite sides of every meter mark along the 50 m transect (50 X 2 = 100).

First hit interceptions were used to calculate absolute top layer foliar cover by dividing the number of interceptions for a particular species or ground cover type by the total number of points taken (100). First hit relative vegetation cover was calculated by dividing first hit absolute cover for each species by the total first hit vegetation cover. All-layer absolute cover was calculated by dividing all hits (first-hits and additional-hits) for a particular species by the total number of points taken (100). In addition, all-layer relative cover was calculated using all hits for a particular species divided by the total hits accumulated during sampling of the transect.

PLANT SPECIES FREQUENCY AND DENSITY MEASUREMENTS

During the course of cover sampling, all plant species occurring within one meter of either side of the cover sample transect were noted as present within each sample. The total number of species (within each lifeform) observed in each 100 sq.m. sample provides a measure of species density, indicating the relative species richness of different areas. Frequency for each plant species observed during sampling was calculated by dividing the number of sample transects in which the species was observed by the total number of samples.

WOODY PLANT DENSITY SAMPLING

Woody plant density sampling was undertaken in all sample areas along each transect established for cover. Trees, shrubs, subshrubs, and agavoids with root crowns located within the boundaries of the quadrats (belt transects) were tallied according to species. In pinyon-juniper areas, woody plant density sampling was collected in 4x50 meter plots, 2 meters on either side of the cover transect. In sagebrush areas, woody plants were counted inside the 2x50 meter transects established for cover. The presence of dead individuals was not included in woody plant density calculations.

LIFEFORMS USED IN DATA PRESENTATION

All data and summary tables are organized by lifeform to facilitate data interpretation and analysis. The lifeform categories that follow reflect growth habit and provenance.

Lifeforms Present in 2003

Native Annual & Biennial Forbs	Native Subshrubs
Introduced Annual & Biennial Forbs	Native Shrubs
Native Annual Grasses	Introduced Shrubs
Introduced Annual Grasses	Native Trees
Native Perennial Forbs	Succulents
Introduced Perennial Forbs	Agavoids
Native Perennial Cool Season Grasses	Lichens
Introduced Perennial Cool Season Grasses	Fungus
Native Perennial Warm Season Grasses	Algae

Both grasses and graminoids (grass-like plants) are included in the Native Perennial Cool Season Grasses lifeform.

PLANT SPECIES LISTING

Scientific names used generally follow McDougall (1973) or Kearney and Peebles (1960) while the common names cited are found in Beetle (1970), Nickerson et al. (1976), or Soil Conservation Service (1979). Lichens and mosses were described in Hale (1969) and Conard (1956), respectively. Scientific names for vascular plants not found in the sources listed above were described by either Welsh et al (1993) or Great Plains Flora Association (1986). The table below lists these species with their sources:

Vascular plants not found in McDougall (1973) or Kearney and Peebles (1960)	Great Plains Flora Association (1986)	Welsh et al. (1993)
Arenaria hookeri	X	X
Bahia oppositifolia	X	
Cryptantha flavolculata		X
Elymus junceus	X	X
Erysimum asperum	X	X
Lygodesmia juncea	X	X
Puccinellia distans	X	X
Stephanomeria runicnata	X	X

During the course of fieldwork, a list of all encountered plant species (quantitative plus incidental observations) was compiled for each area. These lists are summarized in Appendix 2, 'Plant Species from the LOMCRA Baseline Study, All Areas', which includes current nomenclature, cross-references to older nomenclature, common name, and the area in which the species was observed.

RESULTS

Tables containing the LOMCRA baseline sampling data are present in Appendix 1. Results of quantitative cover sampling of sagebrush shrubland are presented in Tables 1 through 9, and data from pinyon-juniper woodland are found in Tables 10 through 19. Woody plant density data from sagebrush shrubland are presented in Tables 20 through 28. Woody plant density data from pinyon-juniper woodland are found in Tables 29 through 38. Cover and woody plant density data are summarized in Table 39. Relative cover data organized by lifeform are presented in Table 40. Data on species density separated by lifeform are present in Table 41. A listing of all plant species encountered during quantitative sampling is provided in Table 42. Photographic documentation from representative quantitative sampling locations is available in Photographs 1 through 92, present in Appendix 4.

DISCUSSION

Sagebrush Shrubland

Areas mapped as sagebrush shrubland in the baseline sampling areas are for the most part dominated by big sagebrush (*Artemisia tridentata*) and blue grama (*Bouteloua gracilis*). Variations from this general statement were typically in the form of varying and

sometimes substantial presence of other shrubs and subshrubs, especially fourwing saltbush (*Atriplex canescens*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), Greene rabbitbrush (*C. greenei*), and rubber rabbitbrush (*C. nauseosus*). Along with blue grama, the grass component of many sagebrush stands included galleta (*Hilaria jamesii*) and, more occasionally, bottlebrush squirreltail (*Sitanion jubatum* and *S. longifolium*), needle and thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), and western wheatgrass (*Agropyron smithii*). However, the latter five cool season grasses were almost always less abundant than the warm season grasses blue grama and galleta. A preponderance of warm season grasses is consistent with environmental conditions that are strongly characterized by low and variable precipitation concentrated in summer "monsoon" episodes. Major exceptions to the strong presence of big sagebrush in this vegetation occur on shallow soils such as are found in J5/6 and J13/14 where woody plant cover is comprised primarily of Douglas rabbitbrush and shadscale saltbush (*Atriplex confertifolia*).

Total vegetation cover in the Douglas rabbitbrush / shadscale variants of the sagebrush shrubland type in J5/6 and J13/14 (Table 39) averaged 8.2 and 8.6 percent, respectively. Areas with the greatest sagebrush cover such as J2, J15, J28, and N12/99 NORTH/SOUTH averaged 14.4, 12.4, 17.2, and 13.8 percent total vegetation cover, respectively. These data suggest that abundance of sagebrush is an indicator of overall soil productivity and that, within the limitations imposed by low annual precipitation, highest cover within the sagebrush type is expectable on the deeper (alluvial / colluvial) substrates.

Bare soil (Table 39) is very abundant within the sagebrush shrubland vegetation type, averaging from 47 to 75 percent cover, while rock, depending on the site, varied from less than 2 percent cover up to 15 percent cover. Rock cover was predictably highest on J5/6 and J13/14 sites where soils are shallow and more rock is exposed. Standing dead was probably more abundant in 2003 than usual because of the widespread death of sagebrush following the 2000-2002 drought (see below). It varied from about 6 to 15 percent cover in the 2003 sampling and was primarily dead big sagebrush.

Relative vegetation cover data (Table 40) show that although shrubs and subshrubs are by far the most abundant lifeforms in the sagebrush shrubland type, warm season grasses in some sampling areas (e.g. J2, J4, J5/6, J8 and J10) contribute from 14 to 44

percent of total vegetation cover. In J15, J28, and N12/N99 NORTH/SOUTH they were much less, averaging 2.8 to 5.6 percent of total vegetation cover.

With regard to woody plant density, the total density within sampled areas for sagebrush shrubland varied from about 3900 stems per acre to 18,000 stems per acre (Table 39). The highest were present on the shallow soil sites at J5/6 and J13/14. The bulk of the high values at these sites were Douglas rabbitbrush, rubber rabbitbrush, and snakeweed (*Gutierrezia sarothrae*). Other shrubs that were encountered during sampling include the subshrubs winterfat (*Ceratoides lanata*), slenderbush wildbuckwheat (*Eriogonum microthecum*), Drummond goldenweed (*Haplopappus drummondii*), granite prickly gilia (*Leptodactylon pungens*), and threadleaf groundsel (*Senecio douglasii* var. *longilobus*), and the shrubs black greasewod (*Sarcobatus vermiculatus*) and gray feltthorn (*Tetradymia canescens*).

Among the sagebrush shrubland sites with deeper soils, invasion of pinyon pine is widespread (Photographs 25, 77, 78). The pines are most often found directly beneath sagebrush where shading or other protection has apparently provided critical assistance in establishment.

That big sagebrush is among the native plants sensitive to moisture deprivation was evident throughout the Black Mesa area in 2003. The effects of serious drought conditions of the previous few years were very clear. Within the baseline areas examined in 2003, it is estimated that approximately 30% of sagebrush shrubland stands had suffered heavy die-back of sagebrush (e.g. Photographs 2, 6, 14, 36, and 79), while another 50 to 60% had experienced light to moderate die-back (e.g. Photographs 3, 18, 26, and 33). About 10 to 20% of stands had little or no die-back (e.g. Photographs 1, 4, 32, and 35). See the discussion of the drought sensitivity of sagebrush in the next section.

Species density (Table 41) within the sampled sagebrush shrubland stands varied from 12.2 species per 100 sq.m. (J4 area) to 19.2 species per 100 sq.m. (J2 area).

Pinyon-Juniper Woodland

Although pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) are by far the most abundant plants on these sites in terms of ground cover and presumably

biomass, their abundance is on the low end of the spectrum for this type in the Southwest (Moir and Carleton 1986). With tree canopy cover mostly in the range of 14 to 18 percent (and ranging down to 8 percent), these sites do not meet the UNESCO definition of woodland (> 40 percent tree cover, UNESCO 1973). Pinyon-juniper vegetation at similar elevation (6300 ft) with the same tree dominants in Zion National Park had 38 percent cover (by ocular estimate; Harper 2003). Inasmuch as trees are by far the most abundant lifeform, it is reasonable to continue to refer to these as woodlands.

Beyond the tree cover, shrubs are the next most abundant lifeform, being comprised of big sagebrush and either fourwing saltbush or cliffrose (*Cowania mexicana*). On the shallow soils at J13/14, accompanying shrubs (or subshrubs) include Douglas rabbitbrush and shadscale saltbush. For the most part, herbaceous cover in all the pinyon-juniper vegetation is very sparse. Warm season grass cover is very limited, mostly considerably less than 1 percent (compared with often 2 to 4 percent cover in sagebrush of the same area). Cool season native grasses are more abundant in the pinyon-juniper vegetation type than in the sagebrush shrubland. More commonly observed species include bottlebrush squirreltail, Indian ricegrass, and muttongrass (*Poa fendleriana*). Native perennial forbs are more frequently encountered in the pinyon-juniper than in sagebrush shrubland, but still are very minor in the quantitative sense. Some pinyon-juniper stands give the general impression of virtually bare understory (e.g. Photographs 41, 45, 49, and 54), while others have at least moderate presence of shrub cover (e.g. Photographs 38, 43, and 63).

Total vegetation cover (Table 39) of as high as 22 percent and as low as 11.6 percent is comparatively sparse for reported pinyon-juniper woodland. Harper (2003) for example, found an average of 62 percent live vegetation cover in his examination of pinyon-juniper woodland at Zion National Park. Rock averaged 17 percent cover over all the stands sampled compared to about 2.5 percent in sagebrush shrubland (exclusive of the shallow soil sites in J5/6 and J13/14). Standing dead of approximately 1 to 5 percent in pinyon–juniper woodland was substantially less than the sagebrush shrubland. Although some pinyon pine did perish as a result of the drought, overall the tree cover was mostly intact. Some of the mortality of pines was indirect, caused by bark beetle infestation of stressed trees.

Study of the ecophysiology of pinyon pine, Utah juniper and sagebrush has shown that the trees have assimilation (carbon-fixation) rates that are more sensitive to drought than sagebrush (DeLucia and Schlesinger 1991), but the trees have higher "water use efficiency" (assimilation rate/transpiration rate). In other words, the trees have much tighter control on transpirative loss, so even though their assimilation drops quickly with drought, they still make a little water go farther per gram of fixed carbon than sagebrush. Flanagan et al. (1992) as cited in Nowak et al. (1999) showed that pinyon pine and Utah juniper are more dependent on summer precipitation than sagebrush.

Occasional trees within the pinyon-juniper stands of the study areas have been removed (Photograph 80) presumably for fuelwood. The major residual evidence is the presence of stumps and litter from limbing the bole.

In the pinyon-juniper type species density (Table 41) varied from 12.2 to 19.8 species per 100 sq. m., essentially the same range observed in sagebrush shrubland. As in sagebrush shrubland, the distribution of species is fairly even among native perennial forbs, native perennial cool season grasses, native perennial warm season grasses, subshrubs, and shrubs. Native annual forb species were distinctly less numerous in the pinyon-juniper than in the sagebrush shrubland. Compared to the range of vascular plant species density observed elsewhere in pinyon–juniper woodlands of adjacent New Mexico and Utah (Harner and Harper 1976), the LOMCRA study areas fall somewhat below the mean of the 30 sample areas reported there which was about 22 to 23 species per 100 sq.m., and ranged from about 12 to 60 species per 100 sq.m.

Throughout the bulk of the pinyon-juniper woodland of the study area, the soil surface is trampled sufficiently frequently by livestock that "cryptobiotic" or "cryptogamic" soil crust is non-existent. In a very few sites, however, this soil crust was found intact (Photographs 81, 82, 83, and 84). The cryptogams involved are predominantly blue-green algae, mosses (mostly *Polytrichum piliferum*), and lichens. Evans and Ehlehringer (1994) found that the nitrogen requirements of Utah juniper may be largely met by nitrogen fixation by the cryptobiotic crust. It may be assumed that the absence of a cryptobiotic crust in heavily trampled areas results in a diminished availability of nitrogen from atmospheric fixation.

With regard to woody plant density in the pinyon-juniper woodland type, overall woody plant densities (including subshrubs, shrubs, and trees) are far lower than in the sagebrush shrubland type, ranging from about 650 to 4000 stems per acre (Table 39). Tree densities were only a fraction of the total woody plant densities, ranging from 69 to 339 tree stems per acre. These values are comparable to the lower to middle range of densities reported for pinyon-juniper stands of the Piceance Basin by Welden et al. (1990) and well below the range reported in 1974 (599 trees per acre) and 1984 (629 trees per acre) from permanent plots in northeastern Utah by Austin (1987).

In areas J4, J8 and J13/14, juniper greatly outnumbered pinyon by as much as 20:1. In J2, J10, J15, and N12/99 NORTH/SOUTH proportions were fairly even, while in J28, N9, and N10 pinyon exceeded juniper by 2:1 to 3:1. This would appear to be related to a gradient of increasing elevation and precipitation from south to north. Pinyon pine has shown physiological evidence of having much higher potential rates of carbon fixation than junipers (Lathja and Barnes 1991), but shows less resistance to impacts of water stress on assimilation rate. Measures of the degree of soil moisture stress at which leaf turgor can no longer be maintained ("permanent wilting point") is an indication of the relative drought tolerance of a plant species. Wilkins and Klopatek (1987) determined that the "permanent wilting point" for pinyon pine was slightly higher than that for Utah juniper. Breashers et al. (1997) studied the use of soil moisture in spaces between trees in a pinyon-juniper woodland and determined that one-seeded juniper made more effective use of shallow soil moisture between trees than pinyon pine.

In other words, pinyon pine is, in general, less accommodating of dry conditions than Utah juniper and, when competition for shallow soil moisture is intense, junipers tend to have an advantage over the pines. Lower relative abundance of pinyon pine in the southern part of the LOMCRA study areas, where elevations and precipitation are lower and soils tend to be shallower (and with presumably less moisture-holding capacity), is consistent with what is known of the ecology of these two tree species.

Densities of subshrubs were highly variable often driven by the extremely local very dense occurrence of snakeweed. At a somewhat larger scale Douglas rabbitbrush or Greene rabbitbrush could be very dense in a general area perhaps reflecting a combination of substrate and land use history.

Occurrence of Forbs in the LOMCRA Study Areas

Historical grazing use of these lands has been so intense and unrelenting that growth of herbaceous species in general, but especially native perennial forbs, is very restricted. Although the complete absence of native perennial forbs in a randomly sampled 100 sq.m. area was uncommon (no more than 2 of 10 such plots in any of the LOMCRA study areas were totally devoid of any native perennial forbs), the extent of native perennial forb cover is extremely limited. In the sagebrush vegetation type, percent cover by native perennial forbs in the various LOMCRA study areas averaged from 0.0 to 0.2 percent, while in the pinyon-juniper woodland, it averaged from 0.0 to 0.4 percent. (0.0 percent cover means less than 0.1 percent cover in most cases, i.e. cover is below the quantitative detection limit).

Most frequently comprising (in the 2003 sampling) the very small cover afforded by native perennial forbs were some few of the following: *Allium macropetalum*, *Astragalus wingatanus*, *Calochortus nuttallii*, *Cryptantha flavoculata*, *Cymopterus purpureus*, *Eriogonum umbellatum*, *Aster arenosus* (*Leucelene ericoides*), *Mirabilis multiflora*, *Oenothera coronopifolia*, *Oxybaphus linearis*, *Pedicularis centrantherum*, *Penstemon linarioides*, *Phlox longifolia*, *Solidago petradoria* (*Petradoria pumila*), *Sphaeralcea coccinea*, *Stanleya pinnata*, and/or *Townsendia exscapa*. Although the spring of 2003 was comparatively favorable with regard to moisture, the extent native annual and biennial forbs was scant, averaging no more than 0.8 percent cover in the sagebrush type and no more than 0.1 percent cover in the pinyon-juniper type. Native annual and biennial species sporadically present included: *Aster canescens*, *Chenopodium fremontii*, *Chenopodium gigantospermum*, *Chenopodium leptophyllum*, *Cryptantha crassicarpa*, *Descurainia pinnata*, *Descurainia richardsonii*, *Gilia aggregata*, *Gilia pumila*, *Gilia sinuata*, *Lappula redowskii* ssp., *Phacelia crenulata*, *Plantago patagonica*, and/or *Townsendia incana*.

Sensitive Plant Survey Results

Survey of the inner (red) areas shown on Map 1 in spring 2003 did not reveal the presence of any of the "target" species (those deemed to have even a small chance of occurrence (see *Appendix 3, Field Guide to Potentially Occurring Rare Plants, Black Mesa Mining Complex)).*

Notes regarding the potential for the sought for rare plants to occur and the results of the intensive survey for them are summarized below:

Amsonia peeblesii – Peebles blue star

This plant is known from grasslands and desert scrub communities at elevations from 4,000 to 5,620 ft., in the arc of the Little Colorado River drainage from central Coconino County south and east into southern Navajo County, Arizona. Even the lowest reaches of the LOMCRA study areas are nearly 1,000 ft. higher than the uppermost occurrence of this plant. The environs of the Little Colorado River to which this plant is restricted are approximately 50 miles distant. No individuals of Peebles blue star were encountered during the 2003 surveys.

Asclepias sanjuanensis – San Juan milkweed

This plant is known from sandy benches and hills in pinyon-juniper woodland vegetation near the Chaco and San Juan Rivers in San Juan County, New Mexico at 5,000 to 6,200 feet. The type locality is on the San Juan College campus in Farmington. In terms of sandy substrate and pinyon-juniper woodland vegetation, the LOMCRA study areas would seem to include suitable habitat. However, its nearest occurrence in areas approximately 150 mi. east and at elevations mostly below the LOMCRA study area elevations (6,200 to 7,150 ft.) made its presence unlikely; none was found during the 2003 surveys.

Astragalus cremnophylax var. *cremnophylax* – Sentry milkvetch

This milkvetch is known from Grand Canyon National Park on Kaibab limestone, a Permian-age formation. LOMCRA study areas do not include limestones and are far younger (Cretaceous-age). Thus no suitable habitat was found and no sentry milkvetch was encountered.

Astragalus cutleri (*A. preusii* var. *cutleri*) – Copper Canyon milkvetch

This plant is an endemic in southern San Juan County, Utah occurring on seleniferous soils derived from the Triassic-age Shinarump Conglomerate member of the Chinle formation at 3,800 ft. The lowest LOMCRA elevations of about 6,200 ft. are substantially higher and no substrates approximating those of the known occurrences are present. No individuals of Copper Canyon milkvetch were encountered during intensive surveys.

Astragalus humillimus – Mancos milkvetch

This plant is known from San Juan County, New Mexico and adjacent Montezuma County, Colorado at elevations from about 5,000 to 6,500 ft. in cracks on "slickrock" exposures of the Cretaceous-age Point Lookout sandstone, which is also found in McKinley and Sandoval Counties, New Mexico in close association with the Satan Tongue member of Mancos Shale. In the LOMCRA study areas, Yale Point sandstone, a facies of the Mesa Verde formation of the Black Mesa Basin, forms limited exposures of bare rock. These sandstones are older than those of the San Juan Basin, the Cretaceous sea having receded from the Black Mesa Basin before it receded from the San Juan Basin. In addition to the differences in substrates, the LOMCRA study areas are mostly higher in elevation than the known occurrences of Mancos milkvetch. No individuals of Mancos milkvetch were found during intensive searches in 2003.

Astragalus naturitensis – Naturita milkvetch

This plant is known from sandstone mesas, ledges, crevices, and slopes from 5,000 to 7,000 ft. in McKinley Co., New Mexico, as well as in southern Utah and southwestern Colorado. Such habitats are present in the LOMCRA study areas; those in the intensive survey areas were found not to be occupied.

Carex specuicola – Navajo sedge

This plant is known to occur in extreme northern Arizona and barely into Utah in seeps and hanging gardens below vertical cliffs of Navajo sandstone at elevations between 4,400 ft and 7,000 ft. No exposures of the lower Jurassic-age Navajo sandstone are present in the LOMCRA study areas. The upper Cretaceous Yale Point sandstone that forms cliffs along washes in the LOMCRA area is generally without development of seepage zones. The very few seepage zones observed during the intensive surveys had extensive crusts of evaporated salt. No individuals of Navajo sedge were observed during the intensive surveys.

Clematis hirsutissima var. *arizonica* – Arizona leather flower

Although the known range of elevational occurrence (6,800 to 9,000 ft) overlaps the elevations of many of the LOMCRA study areas, its preferred habitat is moist portions of mountain meadows, open woods, or thickets in ponderosa pine and mixed conifer forests on soils derived from limestone. On the Navajo Nation, it is known only from the Chuska Mountains and Defiance Plateau. None of the habitat criteria are met in the

LOMCRA sites, and no Arizona leather flower was encountered in the intensive survey areas.

Cystopteris utahensis – Utah bladder-fern

Known from Arizona, Colorado, New Mexico, Texas, and Utah at elevations from 4,200 to 8,800 feet, this plant could reasonably occur in the LOMCRA study areas on the very few sites where cracks in sandstones with calcareous cementation are at least slightly seeping. These locations were examined closely (in N12/N99 NORTH/SOUTH). None were found.

Echinocereus triglochidiatus var. *arizonicus* – Arizona hedgehog cactus

This rare cactus is known from central Arizona at elevations from 3,400 to 6,360 ft. on very rocky sites comprised mostly of boulders and cobbles of orthoclase-rich granite of late Cretaceous age. Other substrates on which it has been found include volcanic tuff and mid-Tertiary age dacite. Substrates of the LOMCRA study areas are distinctly unlike these. In addition, the range of elevations within the LOMCRA sites is 6,200 to 7,150 feet, which is, for the most part, substantially higher than the highest known occurrences of the cactus. These facts made the occurrence of this cactus unlikely in the LOMCRA study areas, and, in fact, no individuals of Arizona hedgehog cactus were encountered during the 2003 surveys.

Errazurizia rotundata – Round dune-broom

This plant is known from an arc of sites within a comparatively narrow elevational range (4,800 to 5,200 ft) from near Tuba City in Coconnino County, Arizona swinging south and east to near Holbrook, in general following the valley of the Little Colorado River. Substrates are of various lithologies, but are apparently coarse and loose. Although the LOMCRA study areas include some loose sands over sandstone, elevations are considerably higher and the LOMCRA sites are about 50 miles east and north from the Little Colorado drainage. No individuals of round dune-broom were encountered during 2003 intensive surveys.

Lesquerella navajoensis – Navajo bladderpod

Navajo bladderpod is known to occur in McKinley County, New Mexico, Apache County, Arizona, and in Utah on windswept exposures of the Todlito limestone member of the Morrison formation at elevations between 7,200 and 7,600 ft. Upper elevations of the

north-most LOMCRA study areas (N9, N10, N12/N99 NORTH/SOUTH) are just below this range, but Morrison formation (Upper Jurassic age) materials are not present at the surface in the Black Mesa Basin. Furthermore the Upper Cretaceous sediments that are present in the LOMCRA study areas do not include limestones. Navajo bladderpod was not considered a likely occurrence in the LOMCRA study areas and none was found during 2003 surveys.

Pediocactus bradyi – Brady pincushion cactus

This narrow endemic is found in Coconino County, Arizona along the rim of Marble Canyon between elevations of 3,400 and 5,200 ft. Substrates are narrowly defined where intermixed Moenkopi and Kaibab formation debris form the soil parent material. LOMCRA study area elevations begin at about 6,200 ft and range upward to about 7,150 ft. Furthermore none of the Upper Cretaceous-age substrates of the LOMCRA areas approximate the Moenkopi or Kaibab formation materials (Upper Triassic to lower Jurassic age). There was almost no chance of finding this cactus, and none were found during 2003 intensive surveys of the LOMCRA study areas.

Pediocactus peeblesianus var. *fickeiseniae* – Fickeisen plains cactus

The known occurrences of this cactus are in Coconino and Mohave Counties, Arizona on soils derived from Kaibab limestone at elevations between 4,000 and 5,600 ft. LOMCRA study area sites are all well above the known elevational limit and limestone-derived soils are not present. Nonetheless, it was sought during the intensive surveys but not found.

Pediocactus peeblesianus var. *peeblesianus* – Navajo plains cactus

This cactus is known from southern Navajo County at elevations from 5,100 to 5,650 ft. in the upper reaches of the Little Colorado River watershed on thin veneers of gravel that are not replicated in the LOMCRA study areas. The elevations of the LOMCRA study areas are well above the highest known occurrence of this cactus. No individuals of Navajo plains cactus were encountered in the intensive field surveys.

Phlox cluteana – Navajo Mountain Phlox

This plant is known from the northern Chuska Mountains, Navajo Mountain, and Black Rock Mountain on the Navajo Nation, and in adjacent New Mexico and Utah at elevations from 6,000 to 10,400 ft. on sandy soils with leaf litter under ponderosa pine,

Gambel oak, and pinyon – juniper woodland. Although it seems likely that the pinyon-juniper woodland habitat in which it is found represents the opposite end of the moisture spectrum from that found in the LOMCRA pinyon-juniper sites, it was sought in the intensive searches of spring 2003, but not found.

Platanthera zothecina – Alcove bog orchid

This plant requires the constant flow of moisture usually in hanging garden / alcove environments and is known from small populations at widely scattered locations in central and northeastern Arizona, east-central Utah, and northwestern Colorado. The northeastern Arizona locations include nearby Tsegi and Betatakin Canyons. Although nearby, these locations are in very deep canyons with overhanging cliffs of Navajo sandstone. The much younger Cretaceous-age sandstones (Yale Point member of the Mesa Verde formation) of the LOMCRA study areas form small cliffs along some of the washes of the area, but nowhere are there deep shady well-wetted sites that would support this plant. The very few appearances of moisture on the LOMCRA cliff sites have only enough flow to periodically bring dissolved salts to the surface where rapid evaporation produces extensive salt crusting.

Puccinellia parishii – Parish's alkaligrass

This rare annual alkaligrass is found on salt-encrusted frequently wet soils at widely disjunct sites from northern and eastern Arizona, to southwestern Colorado and western New Mexico and as far away as San Bernadino County, California. Such microsites are found at a few seepage sites in LOMCRA study area N12/N99 NORTH/SOUTH and along Wild Ram wash in LOMCRA study area J2. Although alkaligrass is present, it is saltmarsh alkaligrass (*Puccinellia fasciculata*), an introduced species now found in the northeastern U.S. and in Arizona, Colorado, and New Mexico. Careful examination of the LOMCRA alkaline/wet soils revealed only this species. Characteristics distinguishing saltmarsh alkaligrass from Parish's alkaligrass include lemmas glabrous and 2 to 2.5 mm long, panicle branches floriferous to the base, and perennial habit.

Sclerocactus mesae-verdae – Mesa Verde Cactus

This cactus is known from San Juan County, New Mexico as well as adjacent Montezuma County, Colorado at elevations from 4,900 to 5,500 ft. on very heavy soils derived from Mancos formation shales or from shaley facies of the overlying Mesa Verde formation. Exposures of Mesa Verde formation facies in the northern Black Mesa Basin

and the LOMCRA study areas in general are dominated by the Yale Point sandstone and extensive areas of heavy clay soils are absent. These rocks are age-equivalent to the upper Mancos and lower Mesa Verde rocks of the San Juan Basin but are not marine deposits (the Cretaceous sea having withdrawn from the Black Mesa Basin earlier). No individuals of Mesa Verde cactus were encountered during the 2003 intensive searches in the LOMCRA study areas.

PLANTS FAIRLY COMMONLY SEEN THAT ARE SIMILAR TO TARGET SPECIES

Asclepias asperula – considerably larger than *A. sanjuanensis* in all dimensions of herbage and flowers, and with flowers with greenish corolla lobes with purplish hoods. *A. sanjuanensis* flowers have purplish corolla lobes with whitish hoods.

Phlox longifolia – This phlox has easily observed bulging intercostal membranes, unlike *P. cluteana*

Echinocereus triglochidiatus var. *mojavensis* — Differs from *E. t. arizonicus* in color, length and diameter of central and radial spines.

Pediocactus simpsonii – Possesses normal spines rather than the corky spines of *P. peeblesianus* var. *fickeiseniae* and *P. p.* var. *peeblesianus.* Possesses central spines, unlike *P. bradyi.*

PLANTS OCCASIONALLY ENCOUNTERED THAT ARE SIMILAR TO TARGET SPECIES

Asclepias involucrata (Photograph 87) – Differs from *A. sanjuanensis* in having cream to greenish flowers.

Puccinellia fasciculata – Differs from *P. parishii* in being perennial and having lemmas glabrous and 2 to 2.5 mm long.

Habitats of the Outer Areas

The areas between the red and blue boundaries on Map 1 were examined in fall 2003 for the presence of habitats either different from those of the inner (blue) areas that were

examined in detail in spring 2003 and / or the same as those in the inner areas that had the potential to support sensitive species. Habitats in the outer areas that were as potentially suitable for *Asclepias sanjuanensis*, *Astragalus humillimus*, and *Astragalus naturitensis* as those in the inner areas were found. It should be noted, of course, that those same types of potentially suitable habitats were found not to support any of these species in the adjacent inner areas in spring 2003 surveys.

No new habitats (i.e. habitats not represented in the inner areas) were found in the fall 2003 examination of the outer areas. No additional wet seepage sites were located. Drainages found in the outer areas were dry and generally heavily trampled by livestock (Photos 88 through 92).

LITERATURE CITED

Arizona Rare Plant Committee. 1999. Arizona Rare Plant Field Guide. A Collaboration of Agencies and Organizations.

Austin, D. 1987. Plant communitiy changes within a mature pinyon-juniper woodland. Great Basin Naturalist 47(1): 96-99.

Beetle, A.A. 1970. Recommended Plant Names. Univ. Wyo. Agr. Expt. Stn. Res. Journal 31, Laramie.

Breashers, D.D., O.B. Myers, S.R. Johnson, C.W. Myer, and S.N. Martens. 1997. Differential use of spatially heterogeneous soil moisture by two semiarid woody species: *Pinus edulis* and *Juniperus monosperma.* J. Ecol. 85:289-299.

Conard, H.S. 1956. How to Know the Mosses and Liverworts. WM. C. Brown Company Publishers, Dubuque. 226 p.

DeLucia, E.D. and W. H. Schlesinger. 1991. Resource-use efficiency and drought tolerance in adjacent Basin and Sierran plants. Ecology 72:51-58.

Ecosphere Environmental Services, Inc. 1995. Endangered, Threatened and Sensitive Plant Field Guide; The Farmington District. Collaboratively prepared by Ecosphere, U.S. Bureau of Land Mangement (BLM), Williams Field Services Co., and El Paso Natural Gas Co.

ESCO Associates Inc. 2000. 1999 Baseline Vegetation Report, J23 Conveyor Alternatives, Black Mesa Mining Complex. Prepared for Peabody Western Coal Company, Flagstaff, AZ.

Evans, R.D. and J.R. Ehleringer. 1994. Water and nitrogen dynamics in an arid woodland. Oecologia 99:233-242.

Flanagan, L.B., J.R. Ehleringer, and J.D. Marshall. 1992. Differential uptake of summer precipitation among co-occurring trees and shrubs in a pinyon-juniper woodland. Plant Cell Environ. 15:831-836.

Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence. 1392 p.

Hale, Mason E. 1969. How to Know the Lichens. Wm. C. Brown Company Publishers, Dubuque. 226 p.

Harner, R.F. and K.T. Harper. 1976. The role of area, heterogeneity, and favorability in plant species diversity of pinyon-juniper ecosystems. Ecology 57:1254-1263.

Harper, K.T. 2003. Pinyon-Juniper woodlands in Zion National Park, Utah. Western Amer. Nat. 63(2):189-202.

Kearney, T. and R. Peebles. 1960. Arizona Flora. University of California Press, Berkeley, CA.

Lathja, K. and F.J. Barnes. 1991. Carbon gain and water use in pinyon pine-juniper woodlands of northern New Mexico: field versus phytotron chamber experiments. Tree Physiol. 9:59-67.

McDougall, W.B. 1973. Seed Plants of Northern Arizona. The Museum of Northern Arizona. Flagstaff. 594 p.

Moir, W.H. and J.O. Carleton. 1986. Classification of pinyon-juniper sites on National Forests in the Southwest. In: Everett, ed. Proceedeings – Pinyon- Juniper Conference. Intermountain Forest and Range Experiment Station Gen. Tech Rpt. INT-215.

Navajo Natural Heritage Program. 2001. Navajo Nation Endangered Species List: Species Accounts. Navajo Nation Natural Heritage Program Department of Fish and Wildlife, Window Rock.

Nickerson, M.F., G.E. Brink, and C. Feddema. 1976. Principal Range Plants of the Central and Southern Rocky Mountains: Names and Symbols. USDA Forest Service Gen. Tech. Rept. RM-20.

Nowak, R.S., D.J. Moore and R.J. Tausch. 1999. Ecophysiological patterns of pinyon and juniper. In: Monsen, S.B. and R. Stevens, comps. Proceedings: Ecology and management of pinyon-juniper communities within the Interior West; Sept. 15-18, 1999; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Proc. RMRS-P-9.

Peabody Coal Company. 1985. Permit Application Package for the Black Mesa and Kayenta Mines, Chapter 9, Vegetation Resources.

Soil Conservation Service (SCS). 1979. Common Plant Names list and Scientific Plant Names List. Exhibit 407.1 (a)(6), National Soils Handbook Part II, USDA, Washington, D.C.

Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado Rare Plant Field Guide. Prepared for the Bureau of Land Management, the U.S. Forest Service and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.

Spahr, R. 1991. Threatened, Endangered, and Sensitive Species of the Intermountain Region. Fisheries and Wildlife Management, Intermountain Region, U.S. Forest Service, Ogden, UT.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 1973. International Classification and Mapping of Vegetation. Series 6, Ecology and Conservation. Paris. 93 pp.

Utah TES Plant Interagency Committee. 1991. Endangered, Threatened and Sensitive Plant Field Guide. U.S. Forest Service, Ogden; National Park Service, UT; Bureau of Land Management, Salt Lake City; U.S. Fish and Wildlife Service, Salt Lake City; Environmental Protection Agency, Region 8, Denver; Navajo Nation, Navajo Natural Heritage Program, Window Rock; Skull Valley Goshute Tribe, Salt Lake City.

Welden, C.W., W.L. Slauson, and R.T. Ward. 1990. Spatial pattern and interference in pinon-juniper woodlands of northwest Colorado. Great Basin Naturalist 50(4):313-320.

Welsh, S.L. et al. 1993. A Utah Flora. Brigham Young University, Provo. 986 p.

Wilkins, S.D. and J.M.Klopatek. 1987. Plant water relations in ecotonal areas of pinyon-juniper and semi-arid shrub ecosystems. In: R.L. Everett, compiler. Proceedings – Pinyon-Juniper Conference. Jan. 13-16, 1986, Reno, NV. USDA Forest Service, Intermountain Research Station, Gen. Tech. Rpt. INT-GTR-215: 412-417.

APPENDIX 1

DATA TABLES

Cover data tables: Both first and additional hit data are presented in these tables. Additional hit data are shown in parentheses.

Woody plant density data tables: Counts of dead shrubs are shown in parentheses but are not included in density totals.

Table 1. Cover Data - J2 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Arenaria hookeri	0.00	20.00	0.00	0.00	0.00				P	
Chaenactis stevioides	0.00	40.00	0.00	0.00	0.00	P				P
Chenopodium leptophyllum	0.00	20.00	0.00	0.00	0.00		P			
Cryptantha crassisepala	0.00	20.00	0.00	0.00	0.00			P		
Cryptantha minima	0.00	20.00	0.00	0.00	0.00	P				
Descurainia pinnata	0.00	60.00	0.00	0.00	0.00	P			P	P
Gilia pumila	0.00	80.00	0.00	0.00	0.00	P	P	P		P
Gilia sinuata	0.00	20.00	0.00	0.00	0.00		P			
Lappula redowskii	0.40	80.00	2.78	0.40	2.78	P	1		1	P
Lappula texana	0.00	20.00	0.00	0.00	0.00			P		
Linum puberulum	0.00	60.00	0.00	0.00	0.00	P	P	P		
Phacelia crenulata	0.00	40.00	0.00	0.00	0.00		P			P
Townsendia incana	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE ANN. & BIEN. FORBS	0.4	100.0	2.8	0.4	2.8	P	1	P	1	P
INTRODUCED ANNUAL & BIENNIAL FORBS										
Chenopodium album	0.00	40.00	0.00	0.00	0.00	P		P		
Salsola kali	0.00	20.00	0.00	0.00	0.00	P				
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	P	---	P	---	---
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.20	100.00	1.39	0.20	1.39	P	P	P	1	P
TOTAL NATIVE ANN. GRASSES	0.2	100.0	1.4	0.2	1.4	P	P	P	1	P
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	60.00	0.00	0.00	0.00	P	P		P	
Calochortus nuttallii	0.00	40.00	0.00	0.00	0.00		P		P	
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00	P				
Cymopterus purpureus	0.00	40.00	0.00	0.00	0.00	P	P			
Delphinium scaposum	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00	P				
Oenothera coronopifolia	0.00	40.00	0.00	0.00	0.00	P				P
Phlox longifolia	0.00	60.00	0.00	0.00	0.00	P		P	P	
Sphaeralcea coccinea	0.00	60.00	0.00	0.00	0.00	P	P		P	
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.40	40.00	2.78	0.40	2.78	P		2		
Oryzopsis hymenoides	0.20	20.00	1.39	0.20	1.39		1			
Sitanion jubatum	0.20	80.00	1.39	0.20	1.39	P	P		1	P
Sitanion longifolium	0.00	20.00	0.00	0.00	0.00				P	
Stipa comata	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL GRASSES (c)	0.8	100.0	5.6	0.8	5.6	P	1	2	1	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	1.40	100.00	9.72	1.40	9.72	2	1	P	3	1
Hilaria jamesii	0.60	100.00	4.17	0.60	4.17	P	2	P	1	P
TOTAL NATIVE PERENNIAL GRASSES (w)	2.0	100.0	13.9	2.0	13.9	2	3	P	4	1
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.80	80.00	5.56	0.80	5.56	1	1	2		P
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00			P		
Eurotia lanata	0.20	20.00	1.39	0.20	1.39		1			
Gutierrezia sarothrae	0.00	60.00	0.00	0.00	0.00			P	P	P
Leptodactylon pungens	0.00	40.00	0.00	0.00	0.00			P	P	
TOTAL NATIVE SUBSHRUBS	1.0	100.0	6.9	1.0	6.9	1	2	2	P	P
NATIVE SHRUBS										
Artemisia tridentata	9.20	100.00	63.89	9.20	63.89	10	6	5	6	19
Chrysothamnus viscidiflorus	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
TOTAL NATIVE SHRUBS	9.2	100.0	63.9	9.2	63.9	10	6	5	6	19

Table 1. Cover Data - J2 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE TREES										
Pinus edulis	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE TREES	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
MOSS										
Moss	0.80	60.00	5.56	0.80	5.56	P		1	3	
TOTAL MOSS	0.8	60.0	5.6	0.8	5.6	P	---	1	3	---
SUCCULENT										
Opuntia fragilis var. fragilis	0.00	20.00	0.00	0.00	0.00			P		
TOTAL SUCCULENT	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
Standing dead	8.40	100.00		8.40		8	18	3	9	4
Litter	16.00	100.00		16.00		20	22	7	17	14
Bare ground	58.00	100.00		58.00		57	38	78	57	60
Rock	3.20	100.00		3.20		2	9	2	1	2
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	14.4 (s=3.8)		100.0	14.4 (s=3.8)	100.0	13	13	10	16	20
GROUND COVER (Litter+Rock+Veg+St.Dead	42.0			42.0		43	62	22	43	40
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 19.2 Std.Dev.= 4.4)						26	20	18	18	14

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 2. Cover Data - J4 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chaenactis stevioides	0.20	20.00	2.17	0.20	2.17				1	
Cryptantha crassisepala	0.20	40.00	2.17	0.20	2.17		1		P	
Descurainia pinnata	0.00	20.00	0.00	0.00	0.00	P				
Gilia pumila	0.00	20.00	0.00	0.00	0.00	P				
Gilia sinuata	0.00	60.00	0.00	0.00	0.00		P		P	P
Lappula redowskii	0.00	60.00	0.00	0.00	0.00	P		P	P	
Linum puberulum	0.00	20.00	0.00	0.00	0.00	P				
Plantago purshii	0.20	40.00	2.17	0.20	2.17				P	1
TOTAL NATIVE ANN. & BIEN. FORBS	0.6	100.0	6.5	0.6	6.5	P	1	P	1	1
NATIVE ANNUAL GRASSES										
Festuca octoflora	1.20	40.00	13.04	1.20	13.04	3				3
TOTAL NATIVE ANN. GRASSES	1.2	40.0	13.0	1.2	13.0	3	---	---	---	3
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	20.00	0.00	0.00	0.00				P	
TOTAL INTRO. ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	---	---	P	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	20.00	0.00	0.00	0.00					P
Calochortus nuttallii	0.00	20.00	0.00	0.00	0.00			P		
Lygodesmia juncea	0.00	20.00	0.00	0.00	0.00	P				
Oenothera coronopifolia	0.20	40.00	2.17	0.20	2.17				P	1
Sphaeralcea coccinea	0.00	40.00	0.00	0.00	0.00	P			P	
TOTAL NATIVE PERENNIAL FORBS	0.2	80.0	2.2	0.2	2.2	P	---	P	P	1
INTRODUCED PERENNIAL FORBS										
Rumex crispus	0.00	20.00	0.00	0.00	0.00		P			
TOTAL INTRO. PERENNIAL FORBS	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.40	40.00	4.35	0.40	4.35	2		P		
Oryzopsis hymenoides	0.00	40.00	0.00	0.00	0.00		P			P
Sitanion longifolium	0.00	20.00	0.00	0.00	0.00					P
Stipa comata	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE PERENNIAL GRASSES (c)	0.4	80.0	4.3	0.4	4.3	2	P	P	---	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	1.20	80.00	13.04	1.20	13.04	2	P	1	3	
Hilaria jamesii	1.00	80.00	10.87	1.00	10.87	1		P	P	4
Sporobolus cryptandrus	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL GRASSES (w)	2.2	100.0	23.9	2.2	23.9	3	P	1	3	4
NATIVE SUBSHRUBS										
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00					P
Gutierrezia sarothrae	0.00	40.00	0.00	0.00	0.00	P				P
Leptodactylon pungens	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE SUBSHRUBS	0.0	40.0	0.0	0.0	0.0	P	---	---	---	P
NATIVE SHRUBS										
Artemisia tridentata	2.60	80.00	28.26	2.60	28.26	3		1	5	4
Atriplex canescens	0.00	20.00	0.00	0.00	0.00					P
Chrysothamnus viscidiflorus	2.00	100.00	21.74	2.00	21.74	2	1	P	5	2
TOTAL NATIVE SHRUBS	4.6	100.0	50.0	4.6	50.0	5	1	1	10	6
NATIVE TREES										
Juniperus osteosperma	0.00	20.00	0.00	0.00	0.00					P
Pinus edulis	0.00	40.00	0.00	0.00	0.00				P	P
TOTAL NATIVE TREES	0.0	40.0	0.0	0.0	0.0	---	---	---	P	P

Table 2. Cover Data - J4 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
MOSS										
Moss	0.00	20.00	0.00	0.00	0.00					P
TOTAL MOSS	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
LICHEN										
Parmelia chlorochroa	0.00	20.00	0.00	0.00	0.00				P	
TOTAL LICHEN	0.0	20.0	0.0	0.0	0.0	---	---	---	P	---
SUCCULENT										
Opuntia macrorhiza	0.00	20.00	0.00	0.00	0.00		P			
Sclerocactus parviflorus	0.00	20.00	0.00	0.00	0.00					P
TOTAL SUCCULENT	0.0	40.0	0.0	0.0	0.0	---	P	---	---	P
Standing dead	10.60	100.00		10.60		6	21	8	6	12
Litter	3.80	100.00		3.80		5	3	1	5	5
Bare ground	74.60	100.00		74.60		74	73	88	70	68
Rock	1.80	80.00		1.80		2	1	1	5	
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	9.2 (s=6.6)		100.0	9.2 (s=6.6)	100.0	13	2	2	14	15
GROUND COVER (Litter+Rock+Veg+St.Dead	25.4			25.4		26	27	12	30	32
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 12.2 Std.Dev.= 4.6)						14	8	7	14	18

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 3. Cover Data - J5/6 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Lappula redowskii	0.40	60.00	4.88	0.40	4.88	2	P		P	
Linum puberulum	0.00	20.00	0.00	0.00	0.00		P			
Plantago pushii	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE ANN. & BIEN. FORBS	0.4	60.0	4.9	0.4	4.9	2	P	---	P	---
INTRODUCED ANNUAL & BIENNIAL FORBS										
Kochia scoparia	0.00	20.00	0.00	0.00	0.00					P
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
NATIVE PERENNIAL FORBS										
Allium macropetalum	0.00	20.00	0.00	0.00	0.00			P		
Aster arenosus	0.00	40.00	0.00	0.00	0.00	P	P			
Calochortus nuttallii	0.00	40.00	0.00	0.00	0.00		P	P		
Cryptantha sp.	0.20	60.00	2.44	0.20	2.44		1	P	P	
Delphinium scaposum	0.00	20.00	0.00	0.00	0.00			P		
Oenothera coronopifolia	0.00	20.00	0.00	0.00	0.00	P				
Oxybaphus linearis	0.00	20.00	0.00	0.00	0.00		P			
Sphaeralcea coccinea	0.00	80.00	0.00	0.00	0.00	P	P	P		P
Townsendia exscapa	0.00	20.00	0.00	0.00	0.00			P		
TOTAL NATIVE PERENNIAL FORBS	0.2	100.0	2.4	0.2	2.4	P	1	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.00	80.00	0.00	0.00	0.00	P	P	P	P	
Stipa comata	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	80.0	0.0	0.0	0.0	P	P	P	P	---
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	60.00	0.00	0.00	0.00	P	P		P	
Bouteloua gracilis	1.80	100.00	21.95	1.80	21.95	1	P	4	3	1
Hilaria jamesii	0.60	100.00	7.32	0.60	7.32	P	1	P	2	P
Sporobolus airoides	0.20	60.00	2.44	0.20	2.44			1	P	P
TOTAL NATIVE PERENNIAL GRASSES (w)	2.6	100.0	31.7	2.6	31.7	1	1	5	5	1
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.60	80.00	7.32	0.60	7.32	2	1		P	P
Eurotia lanata	0.00	40.00	0.00	0.00	0.00	P			P	
Gutierrezia sarothrae	0.40	60.00	4.88	0.40	4.88	P	P		2	
Haplopappus drummondii	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE SUBSHRUBS	1.0	80.0	12.2	1.0	12.2	2	1	---	2	P
NATIVE SHRUBS										
Artemisia tridentata	0.40	60.00	4.88	0.40	4.88	2			P	P
Atriplex canescens	0.00	20.00	0.00	0.00	0.00			P		
Atriplex confertifolia	0.80	80.00	9.76	0.80	9.76	P	1	P	3	
Chrysothamnus viscidiflorus	2.60	100.00	31.71	2.60	31.71	1	2	4	2	4
Sarcobatus vermiculatus	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE SHRUBS	3.8	100.0	46.3	3.8	46.3	3	3	4	5	4
SUCCULENT										
Opuntia macrorhiza	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Opuntia polyacantha	0.20	60.00	2.44	0.20	2.44	P		P	1	
TOTAL SUCCULENT	0.2	100.0	2.4	0.2	2.4	P	P	P	1	P

Table 3. Cover Data - J5/6 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
Standing dead	8.00	100.00		8.00		9	4	13	9	5
Litter	10.40	100.00		10.40		10	11	14	3	14
Bare ground	62.20	100.00		62.20		59	51	61	71	69
Rock	11.20	100.00		11.20		14	28	3	4	7
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	8.2 (s=3.1)		100.0	8.2 (s=3.1)	100.0	8	6	9	13	5
GROUND COVER (Litter+Rock+Veg+St.Dead	37.8			37.8		41	49	39	29	31
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.0 Std.Dev.= 3.5)						17	16	15	18	9

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 4. Cover Data - J8 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Gilia sinuata	0.00	20.00	0.00	0.00	0.00		P			
Linum puberulum	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	---	P	---	P	---
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.60	20.00	8.57	0.60	8.57			3		
TOTAL NATIVE ANN. GRASSES	0.6	20.0	8.6	0.6	8.6	---	---	3	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Aster sp.	0.00	20.00	0.00	0.00	0.00				P	
Calochortus nuttallii	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Cryptantha sp.	0.00	20.00	0.00	0.00	0.00			P		
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00					P
Cymopterus purpureus	0.00	20.00	0.00	0.00	0.00				P	
Oenothera coronopifolia	0.00	20.00	0.00	0.00	0.00	P				
Sphaeralcea coccinea	0.20	100.00	2.86	0.20	2.86	P	1	P	P	P
Sphaeralcea parvifolia	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE PERENNIAL FORBS	0.2	100.0	2.9	0.2	2.9	P	1	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.00	20.00	0.00	0.00	0.00		P			
Oryzopsis hymenoides	0.00	20.00	0.00	0.00	0.00			P		
Sitanion longifolium	0.00	40.00	0.00	0.00	0.00		P	P		
Stipa comata	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	40.0	0.0	0.0	0.0	---	P	P	---	---
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	20.00	0.00	0.00	0.00			P		
Bouteloua gracilis	1.40	80.00	20.00	1.40	20.00	P	1	2	4	
Hilaria jamesii	0.60	80.00	8.57	0.60	8.57		P	P	2	1
TOTAL NATIVE PERENNIAL GRASSES (w)	2.0	100.0	28.6	2.0	28.6	P	1	2	6	1
NATIVE SUBSHRUBS										
Chrysothamnus depressus	0.00	20.00	0.00	0.00	0.00				P	
Chrysothamnus greenei	0.20	20.00	2.86	0.20	2.86			1		
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00					P
Eurotia lanata	0.00	60.00	0.00	0.00	0.00	P	P			P
Gutierrezia sarothrae	0.00	40.00	0.00	0.00	0.00	P		P		
TOTAL NATIVE SUBSHRUBS	0.2	100.0	2.9	0.2	2.9	P	P	1	P	P
NATIVE SHRUBS										
Artemisia tridentata	1.20	100.00	17.14	1.20	17.14	P	2	P	P	4
Atriplex canescens	1.00	60.00	14.29	1.00	14.29	3		1		1
Atriplex confertifolia	0.60	40.00	8.57	0.60	8.57	3			P	
Chrysothamnus viscidiflorus	0.60	100.00	8.57	0.60	8.57	1	P	P	P	2
Lycium pallidum	0.00	40.00	0.00	0.00	0.00	P				P
Sarcobatus vermiculatus	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE SHRUBS	3.4	100.0	48.6	3.4	48.6	7	2	1	P	7
NATIVE TREES										
Juniperus osteosperma	0.40	40.00	5.71	0.40	5.71		1	1		
Pinus edulis	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE TREES	0.4	60.0	5.7	0.4	5.7	---	1	1	---	P
MOSS										
Moss	0.20	20.00	2.86	0.20	2.86				1	
TOTAL MOSS	0.2	20.0	2.9	0.2	2.9	---	---	---	1	---

Table 4. Cover Data - J8 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
SUCCULENT										
Opuntia whipplei	0.00	20.00	0.00	0.00	0.00			P		
TOTAL SUCCULENT	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
Standing dead	11.80	100.00		11.80		3	20	14	14	8
Litter	8.40	100.00		8.40		10	8	9	3	12
Bare ground	61.00	100.00		61.00		61	63	69	70	42
Rock	11.80	80.00		11.80		19	4		6	30
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	7.0 (s=1.2)		100.0	7.0 (s=1.2)	100.0	7	5	8	7	8
GROUND COVER (Litter+Rock+Veg+St.Dead	39.0			39.0		39	37	31	30	58
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 13.6 Std.Dev.= 1.9)						13	12	17	13	13

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 5. Cover Data - J10 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Gilia pumila	0.00	40.00	0.00	0.00	0.00	P	P			
Gilia sinuata	0.00	20.00	0.00	0.00	0.00		P			
Lappula redowskii	0.00	80.00	0.00	0.00	0.00	P	P		P	P
Linanthus aureus	0.00	20.00	0.00	0.00	0.00					P
Oenothera albicaulis	0.00	40.00	0.00	0.00	0.00	P	P			
Plantago purshii	0.00	40.00	0.00	0.00	0.00	P	P			
Townsendia incana	0.00	40.00	0.00	0.00	0.00	P	P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.40	60.00	3.77	0.40	3.70	P	P			2
TOTAL NATIVE ANN. GRASSES	0.4	60.0	3.8	0.4	3.7	P	P	---	---	2
NATIVE PERENNIAL FORBS										
Allium macropetalum	0.00	40.00	0.00	0.00	0.00		P	P		
Aster arenosus	0.00	80.00	0.00	0.00	0.00	P	P	P		P
Cryptantha sp.	0.00	40.00	0.00	0.00	0.00		P			P
Delphinium scaposum	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00			P		
Sphaeralcea coccinea	0.00	60.00	0.00	0.00	0.00	P	P	P		
Townsendia exscapa	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE PERENNIAL FORBS	0.0	80.0	0.0	0.0	0.0	P	P	P	---	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.20	40.00	1.89	0.20	1.85			P	1	
Oryzopsis hymenoides	0.20	100.00	1.89	0.20	1.85	P	1	P	P	P
Poa fendleriana	0.00	20.00	0.00	0.00	0.00			P		
Sitanion longifolium	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Stipa comata	0.00	80.00	0.00	0.00	0.00	P		P	P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.4	100.0	3.8	0.4	3.7	P	1	P	1	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	2.60	80.00	24.53	2.80	25.93	5(1)	5		P	3
Hilaria jamesii	0.40	80.00	3.77	0.40	3.70	P	P	P		2
TOTAL NATIVE PERENNIAL GRASSES (w)	3.0	100.0	28.3	3.2	29.6	5(1)	5	P	P	5
NATIVE SUBSHRUBS										
Artemisia frigida	0.00	20.00	0.00	0.00	0.00				P	
Chrysothamnus greenei	0.20	80.00	1.89	0.20	1.85	P	P	P		1
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00		P			
Eurotia lanata	0.00	40.00	0.00	0.00	0.00	P				P
Gutierrezia sarothrae	0.00	40.00	0.00	0.00	0.00		P			P
Leptodactylon pungens	0.00	60.00	0.00	0.00	0.00		P		P	P
TOTAL NATIVE SUBSHRUBS	0.2	100.0	1.9	0.2	1.9	P	P	P	P	1
NATIVE SHRUBS										
Artemisia tridentata	4.00	100.00	37.74	4.00	37.04	5	8	3	2	2
Atriplex canescens	1.20	40.00	11.32	1.20	11.11			2	4	
Chrysothamnus nauseosus	0.00	20.00	0.00	0.00	0.00				P	
Chrysothamnus viscidiflorus	0.00	60.00	0.00	0.00	0.00			P	P	P
Sarcobatus vermiculatus	0.20	20.00	1.89	0.20	1.85				1	
Tetradymia canescens	0.20	20.00	1.89	0.20	1.85			1		
TOTAL NATIVE SHRUBS	5.6	100.0	52.8	5.6	51.9	5	8	6	7	2
NATIVE TREES										
Juniperus osteosperma	0.00	20.00	0.00	0.00	0.00	P				
Pinus edulis	1.00	60.00	9.43	1.00	9.26		P	P		5
TOTAL NATIVE TREES	1.0	80.0	9.4	1.0	9.3	P	P	P	---	5

Table 5. Cover Data - J10 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	
LICHEN										
Parmelia chlorochroa	0.00	20.00	0.00	0.00	0.00		P			
TOTAL LICHEN	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
SUCCULENT										
Opuntia macrorhiza	0.00	20.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
Standing dead	10.40	100.00		10.40		9	9	8	13	13
Litter	12.60	100.00		12.60		15	14	11	6	17
Bare ground	63.40	100.00		63.40		66	58	65	73	55
Rock	3.00	40.00		3.00			5	10		
TOTALS	100.0			100.2		100	100	100	100	100
TOTAL VEGETATION COVER	10.6 (s=3.8)		100.0	10.8 (s=3.8)	100.0	10(1)	14	6	8	15
GROUND COVER (Litter+Rock+Veg+St.Dead	36.6			36.8		34(1)	42	35	27	45
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 17.6 Std.Dev.= 3.7)						19	23	16	13	17

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 6. Cover Data - J13/14 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Cryptantha crassisepala	0.20	20.00	2.33	0.20	2.33				1	
Lappula redowskii	0.20	40.00	2.33	0.20	2.33				1	P
Linum puberulum	0.00	20.00	0.00	0.00	0.00	P				
Townsendia incana	0.00	40.00	0.00	0.00	0.00	P			P	
TOTAL NATIVE ANN. & BIEN. FORBS	0.4	60.0	4.7	0.4	4.7	P	---	---	2	P
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	60.00	0.00	0.00	0.00	P		P	P	
Calochortus nuttallii	0.00	40.00	0.00	0.00	0.00	P				P
Cryptantha sp.	0.00	20.00	0.00	0.00	0.00					P
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00		P			
Cymopterus purpureus	0.00	40.00	0.00	0.00	0.00	P	P			
Eriogonum leptophyllum	0.00	20.00	0.00	0.00	0.00				P	
Eriogonum umbellatum	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00		P			
Oxybaphus linearis	0.00	40.00	0.00	0.00	0.00		P	P		
Sphaeralcea coccinea	0.20	100.00	2.33	0.20	2.33	P	P	P	1	P
TOTAL NATIVE PERENNIAL FORBS	0.2	100.0	2.3	0.2	2.3	P	P	P	1	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.40	60.00	4.65	0.40	4.65	P		1	1	
Stipa comata	0.00	60.00	0.00	0.00	0.00			P	P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.4	80.0	4.7	0.4	4.7	P	---	1	1	P
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	40.00	0.00	0.00	0.00				P	P
Bouteloua gracilis	3.40	100.00	39.53	3.40	39.53	1	P	3	1	12
Hilaria jamesii	0.40	80.00	4.65	0.40	4.65	1	P	P	1	
Sporobolus airoides	0.00	40.00	0.00	0.00	0.00	P	P			
TOTAL NATIVE PERENNIAL GRASSES (w)	3.8	100.0	44.2	3.8	44.2	2	P	3	2	12
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.00	20.00	0.00	0.00	0.00			P		
Eurotia lanata	0.00	20.00	0.00	0.00	0.00			P		
Gutierrezia sarothrae	0.00	60.00	0.00	0.00	0.00		P	P		P
Haplopappus drummondii	0.00	20.00	0.00	0.00	0.00				P	
Senecio douglasii var. longilobus	0.00	20.00	0.00	0.00	0.00			P		
TOTAL NATIVE SUBSHRUBS	0.0	80.0	0.0	0.0	0.0	---	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	0.20	20.00	2.33	0.20	2.33		1			
Atriplex confertifolia	0.40	40.00	4.65	0.40	4.65	2	P			
Chrysothamnus viscidiflorus	2.60	100.00	30.23	2.60	30.23	P	P	2	8	3
Sarcobatus vermiculatus	0.20	20.00	2.33	0.20	2.33		1			
TOTAL NATIVE SHRUBS	3.4	100.0	39.5	3.4	39.5	2	2	2	8	3
NATIVE TREES										
Juniperus osteosperma	0.40	20.00	4.65	0.40	4.65			2		
TOTAL NATIVE TREES	0.4	20.0	4.7	0.4	4.7	---	---	2	---	---
SUCCULENT										
Opuntia macrorhiza	0.00	40.00	0.00	0.00	0.00	P				P
Opuntia whipplei	0.00	20.00	0.00	0.00	0.00	P				
Pediocactus simpsonii	0.00	20.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.0	40.0	0.0	0.0	0.0	P	---	---	---	P

Table 6. Cover Data - J13/14 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
Standing dead	9.00	100.00		9.00		11	8	2	7	17
Litter	7.60	100.00		7.60		10	10	10	6	2
Bare ground	59.40	100.00		59.40		52	49	72	60	64
Rock	15.40	100.00		15.40		23	31	8	13	2
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	8.6 (s=5.8)		100.0	8.6 (s=5.8)	100.0	4	2	8	14	15
GROUND COVER (Litter+Rock+Veg+St.Dead	40.6			40.6		48	51	28	40	36
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 10.0 Std.Dev.= 5.8)						0	14	13	13	10

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 7. Cover Data - J15 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chenopodium berlandieri	0.00	20.00	0.00	0.00	0.00		P			
Descurainia pinnata	0.00	40.00	0.00	0.00	0.00	P				P
Gilia pumila	0.00	40.00	0.00	0.00	0.00		P			P
Gilia sinuata	0.00	60.00	0.00	0.00	0.00	P			P	P
Lappula redowskii	0.60	100.00	4.84	0.60	4.84	P	P	2	P	1
Linum puberulum	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.6	100.0	4.8	0.6	4.8	P	P	2	P	1
INTRODUCED ANNUAL & BIENNIAL FORBS										
Chenopodium album	0.00	20.00	0.00	0.00	0.00			P		
Tragopogon dubius	0.00	20.00	0.00	0.00	0.00					P
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	---	---	P	---	P
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
NATIVE PERENNIAL FORBS										
Aster arenosus	0.20	60.00	1.61	0.20	1.61	P	P		1	
Calochortus nuttallii	0.00	60.00	0.00	0.00	0.00		P	P	P	
Cymopterus purpureus	0.00	20.00	0.00	0.00	0.00	P				
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00	P				
Oenothera coronopifolia	0.00	20.00	0.00	0.00	0.00					P
Phlox longifolia	0.00	20.00	0.00	0.00	0.00					P
Sphaeralcea coccinea	0.00	80.00	0.00	0.00	0.00	P		P	P	P
TOTAL NATIVE PERENNIAL FORBS	0.2	100.0	1.6	0.2	1.6	P	P	P	1	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron dasystachyum	0.20	20.00	1.61	0.20	1.61					1
Agropyron smithii	0.00	80.00	0.00	0.00	0.00		P	P	P	P
Oryzopsis hymenoides	0.00	80.00	0.00	0.00	0.00	P	P		P	P
Sitanion jubatum	0.20	100.00	1.61	0.20	1.61	P	P	P	1	P
Stipa comata	0.20	40.00	1.61	0.20	1.61				P	1
TOTAL NATIVE PERENNIAL GRASSES (c)	0.6	100.0	4.8	0.6	4.8	P	P	P	1	2
INTRODUCED PERENNIAL GRASSES (cool)										
Elymus junceus	0.20	20.00	1.61	0.20	1.61				1	
TOTAL INTRO. PERENNIAL GRASSES (c)	0.2	20.0	1.6	0.2	1.6	---	---	---	1	---
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.20	100.00	1.61	0.20	1.61	P	P	P	1	P
Hilaria jamesii	0.20	60.00	1.61	0.20	1.61	1		P		P
Sporobolus cryptandrus	0.00	40.00	0.00	0.00	0.00		P	P		
TOTAL NATIVE PERENNIAL GRASSES (w)	0.4	100.0	3.2	0.4	3.2	1	P	P	1	P
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.00	20.00	0.00	0.00	0.00	P				
Eurotia lanata	0.00	40.00	0.00	0.00	0.00	P	P			
Gutierrezia sarothrae	0.00	60.00	0.00	0.00	0.00	P			P	P
TOTAL NATIVE SUBSHRUBS	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P
NATIVE SHRUBS										
Artemisia tridentata	8.00	100.00	64.52	8.00	64.52	10	12	9	4	5
Atriplex canescens	0.20	40.00	1.61	0.20	1.61				P	1
Atriplex confertifolia	0.00	20.00	0.00	0.00	0.00					P
Chrysothamnus nauseosus	0.00	20.00	0.00	0.00	0.00		P			
Chrysothamnus viscidiflorus	0.40	80.00	3.23	0.40	3.23	1	1	P		P
TOTAL NATIVE SHRUBS	8.6	100.0	69.4	8.6	69.4	11	13	9	4	6

Table 7. Cover Data - J15 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE TREES										
Juniperus osteosperma	0.60	60.00	4.84	0.60	4.84	1			2	P
Pinus edulis	1.00	80.00	8.06	1.00	8.06	5	P		P	P
TOTAL NATIVE TREES	1.6	80.0	12.9	1.6	12.9	6	P	---	2	P
MOSS										
Moss	0.20	20.00	1.61	0.20	1.61					1
TOTAL MOSS	0.2	20.0	1.6	0.2	1.6	---	---	---	---	1
Standing dead	6.20	100.00		6.20		4	12	4	5	6
Litter	17.40	100.00		17.40		15	22	9	28	13
Bare ground	62.40	100.00		62.40		60	53	76	52	71
Rock	1.60	40.00		1.60		3			5	
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	12.4 (s=3.4)		100.0	12.4 (s=3.4)	100.0	18	13	11	10	10
GROUND COVER (Litter+Rock+Veg+St.Dead	37.6			37.6		40	47	24	48	29
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 17.0 Std.Dev.= 4.7)						18	16	11	16	24

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 8. Cover Data - J28 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Aster canescens	0.00	40.00	0.00	0.00	0.00				P	P
Chenopodium glaucum	0.00	20.00	0.00	0.00	0.00					P
Chenopodium hians	0.00	40.00	0.00	0.00	0.00				P	P
Chenopodium leptophyllum	0.00	60.00	0.00	0.00	0.00		P		P	P
Cryptantha crassisepala	0.00	40.00	0.00	0.00	0.00	P				P
Descurainia pinnata	0.40	80.00	2.33	0.40	2.25	2	P		P	P
Descurainia richardsonii	0.00	40.00	0.00	0.00	0.00		P		P	
Gilia pumila	0.20	40.00	1.16	0.20	1.12		1		P	
Lappula redowskii	0.20	100.00	1.16	0.20	1.12	1	P	P	P	P
TOTAL NATIVE ANN. & BIEN. FORBS	0.8	100.0	4.7	0.8	4.5	3	1	P	P	P
INTRODUCED ANNUAL & BIENNIAL FORBS										
Chenopodium album	0.00	80.00	0.00	0.00	0.00	P	P		P	P
Salsola kali	0.00	40.00	0.00	0.00	0.00	P				P
Solanum sarachoides	0.20	20.00	1.16	0.20	1.12					1
TOTAL INTRO. ANN. & BIEN. FORBS	0.2	80.0	1.2	0.2	1.1	P	P	---	P	1
NATIVE ANNUAL GRASSES										
Festuca octoflora	1.00	60.00	5.81	1.20	6.74	P	1		4(1)	
Munroa squarrosa	0.20	20.00	1.16	0.20	1.12				1	
TOTAL NATIVE ANN. GRASSES	1.2	60.0	7.0	1.4	7.9	P	1	---	5(1)	---
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	60.00	0.00	0.00	0.00		P		P	P
TOTAL INTRO. ANN. GRASSES	0.0	60.0	0.0	0.0	0.0	---	P	---	P	P
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	60.00	0.00	0.00	0.00		P	P	P	
Penstemon sp.	0.00	20.00	0.00	0.00	0.00			P		
Phlox longifolia	0.00	20.00	0.00	0.00	0.00			P		
Sphaeralcea coccinea	0.00	60.00	0.00	0.00	0.00	P		P		P
Townsendia exscapa	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.00	60.00	0.00	0.00	0.00		P	P		P
Oryzopsis hymenoides	0.00	20.00	0.00	0.00	0.00				P	
Sitanion jubatum	0.20	40.00	1.16	0.40	2.25				1(1)	P
Sitanion longifolium	0.00	80.00	0.00	0.20	1.12	P	(1)	P	P	
Stipa comata	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	100.0	1.2	0.6	3.4	P	(1)	P	1(1)	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	1.00	80.00	5.81	1.00	5.62	P	4	P	1	
Hilaria jamesii	0.00	20.00	0.00	0.00	0.00				P	
Sporobolus cryptandrus	0.00	40.00	0.00	0.00	0.00	P				P
TOTAL NATIVE PERENNIAL GRASSES (w)	1.0	100.0	5.8	1.0	5.6	P	4	P	1	P
NATIVE SUBSHRUBS										
Chrysothamnus greenei	2.20	60.00	12.79	2.20	12.36	8	P	3		
Gutierrezia sarothrae	0.00	60.00	0.00	0.00	0.00		P		P	P
TOTAL NATIVE SUBSHRUBS	2.2	100.0	12.8	2.2	12.4	8	P	3	P	P
NATIVE SHRUBS										
Artemisia tridentata	10.20	100.00	59.30	10.20	57.30	1	22	3	14	11
Atriplex canescens	0.20	60.00	1.16	0.20	1.12		1	P		P
Chrysothamnus viscidiflorus	0.20	40.00	1.16	0.20	1.12			P		1
Sarcobatus vermiculatus	0.80	20.00	4.65	0.80	4.49					4
TOTAL NATIVE SHRUBS	11.4	100.0	66.3	11.4	64.0	1	23	3	14	16

Table 8. Cover Data - J28 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number-- 1	2	3	4	
NATIVE TREES										
Pinus edulis	0.20	40.00	1.16	0.20	1.12				1	P
TOTAL NATIVE TREES	0.2	40.0	1.2	0.2	1.1	---	---	---	1	P
MOSS										
Moss	0.00	40.00	0.00	0.00	0.00		P		P	
TOTAL MOSS	0.0	40.0	0.0	0.0	0.0	---	P	---	P	---
LICHEN										
Parmelia chlorochroa	0.00	40.00	0.00	0.00	0.00		P		P	
TOTAL LICHEN	0.0	40.0	0.0	0.0	0.0	---	P	---	P	---
SUCCULENT										
Opuntia macrorhiza	0.00	80.00	0.00	0.00	0.00	P	P		P	P
TOTAL SUCCULENT	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P
Standing dead	8.20	100.00		8.20		3	21	4	11	2
Litter	6.60	100.00		6.60		5	4	6	5	13
Bare ground	66.60	100.00		66.60		80	46	78	62	67
Rock	1.40	40.00		1.40				6		1
TOTALS	100.0			100.6		100	100	100	100	100
TOTAL VEGETATION COVER	17.2 (s=8.9)		100.0	17.8 (s=9.5)	100.0	12	29(1)	6	22(2)	17
GROUND COVER (Litter+Rock+Veg+St.Dead	33.4			34.0		20	54(1)	22	38(2)	33
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 18.2 Std.Dev.= 5.6)						13	19	12	25	

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 9. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Aster canescens	0.00	20.00	0.00	0.00	0.00	P				
Chenopodium leptophyllum	0.00	40.00	0.00	0.00	0.00			P	P	
Descurainia pinnata	0.00	20.00	0.00	0.00	0.00			P		
Gilia sinuata	0.00	20.00	0.00	0.00	0.00					P
Lappula redowskii	0.60	80.00	4.35	0.60	4.23	P	P	3		P
TOTAL NATIVE ANN. & BIEN. FORBS	0.6	100.0	4.3	0.6	4.2	P	P	3	P	P
INTRODUCED ANNUAL & BIENNIAL FORBS										
Sisymbrium altissimum	0.00	20.00	0.00	0.00	0.00			P		
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	60.00	0.00	0.00	0.00	P			P	P
Bahia oppositifolia	0.00	20.00	0.00	0.00	0.00					P
Calochortus nuttallii	0.00	40.00	0.00	0.00	0.00			P		P
Phlox longifolia	0.00	40.00	0.00	0.00	0.00			P	P	
Sphaeralcea coccinea	0.00	80.00	0.00	0.00	0.00	P		P	P	P
TOTAL NATIVE PERENNIAL FORBS	0.0	80.0	0.0	0.0	0.0	P	---	P	P	P
INTRODUCED PERENNIAL FORBS										
Corydalis aurea	0.00	20.00	0.00	0.00	0.00			P		
TOTAL INTRO. PERENNIAL FORBS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.20	80.00	1.45	0.40	2.82		1	(1)	P	P
Oryzopsis hymenoides	0.00	40.00	0.00	0.00	0.00			P		P
Sitanion longifolium	0.00	60.00	0.00	0.00	0.00			P	P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	80.0	1.4	0.4	2.8	---	1	(1)	P	P
INTRODUCED PERENNIAL GRASSES (cool)										
Poa compressa	0.00	20.00	0.00	0.00	0.00		P			
TOTAL INTRO. PERENNIAL GRASSES (c)	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.20	40.00	1.45	0.20	1.41	P				1
Hilaria jamesii	0.00	40.00	0.00	0.20	1.41	P				(1)
Sporobolus cryptandrus	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL GRASSES (w)	0.2	60.0	1.4	0.4	2.8	P	P	---	---	1(1)
NATIVE SUBSHRUBS										
Artemisia frigida	0.00	20.00	0.00	0.00	0.00		P			
Chrysothamnus greenei	0.00	40.00	0.00	0.00	0.00				P	P
Eurotia lanata	0.00	20.00	0.00	0.00	0.00			P		
Gutierrezia sarothrae	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE SUBSHRUBS	0.0	80.0	0.0	0.0	0.0	---	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	9.60	100.00	69.57	9.60	67.61	6	11	7	6	18
Atriplex canescens	1.20	60.00	8.70	1.20	8.45	1		3	2	
Chrysothamnus nauseosus	1.40	20.00	10.14	1.40	9.86		7			
Chrysothamnus viscidiflorus	0.20	60.00	1.45	0.20	1.41	P		1		P
TOTAL NATIVE SHRUBS	12.4	100.0	89.9	12.4	87.3	7	18	11	8	18
INTRODUCED SHRUBS										
Tamarix pentandra	0.00	20.00	0.00	0.00	0.00		P			
TOTAL INTRODUCED SHRUBS	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
NATIVE TREES										
Pinus edulis	0.40	60.00	2.90	0.40	2.82	1	1			P
TOTAL NATIVE TREES	0.4	60.0	2.9	0.4	2.8	1	1	---	---	P

Table 9. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number-- 1	2	3	4	
MOSS										
Moss	0.00	20.00	0.00	0.00	0.00	P				
TOTAL MOSS	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
LICHEN										
Parmelia chlorochroa	0.00	20.00	0.00	0.00	0.00					P
TOTAL LICHEN	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
SUCCULENT										
Opuntia macrorhiza	0.00	20.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
Standing dead	15.20	100.00		15.20		15	23	12	19	7
Litter	21.00	100.00		21.00		2	25	34	25	19
Bare ground	46.80	100.00		46.80		70	30	37	46	51
Rock	3.20	100.00		3.20		5	2	3	2	4
TOTALS	100.0			100.4		100	100	100	100	100
TOTAL VEGETATION COVER	13.8 (s=5.8)		100.0	14.2 (s=6.0)	100.0	8	20	14(1)	8	19(1)
GROUND COVER (Litter+Rock+Veg+St.Dead	53.2			53.6		30	70	63(1)	54	49(1)
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 12.4 Std.Dev.= 3.0)						12	9	15	10	16

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 10. Cover Data - J2 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Cryptantha crassisepala	0.00	20.00	0.00	0.00	0.00				P	
Descurainia pinnata	0.00	40.00	0.00	0.00	0.00	P	P			
Lappula redowskii	0.00	20.00	0.00	0.00	0.00					P
Lappula texana	0.00	20.00	0.00	0.00	0.00				P	
Linum puberulum	0.00	20.00	0.00	0.00	0.00				P	
Mentzelia albicaulis	0.00	20.00	0.00	0.00	0.00					P
Phacelia crenulata	0.00	20.00	0.00	0.00	0.00					P
Plantago purshii	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
NATIVE PERENNIAL FORBS										
Asclepias involucrata	0.00	20.00	0.00	0.00	0.00				P	
Aster arenosus	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Astragalus praelongus	0.00	20.00	0.00	0.00	0.00					P
Astragalus wingatanus	0.00	20.00	0.00	0.00	0.00		P			
Calochortus nuttallii	0.00	20.00	0.00	0.00	0.00				P	
Cymopterus purpurascens	0.00	60.00	0.00	0.00	0.00	P		P	P	
Euphorbia fendleri	0.00	40.00	0.00	0.00	0.00	P			P	
Haplopappus nuttallii	0.00	20.00	0.00	0.00	0.00		P			
Hymenopappus pauciflorus	0.00	20.00	0.00	0.00	0.00		P			
Oxybaphus linearis	0.00	20.00	0.00	0.00	0.00				P	
Phlox longifolia	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.00	20.00	0.00	0.00	0.00					P
Oryzopsis hymenoides	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Poa fendleriana	0.20	60.00	1.02	0.40	2.02	(1)		P	1	
Sitanion jubatum	0.00	40.00	0.00	0.00	0.00			P		P
Stipa comata	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	100.0	1.0	0.4	2.0	(1)	P	P	1	P
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	20.00	0.00	0.00	0.00					P
Bouteloua gracilis	0.40	100.00	2.04	0.40	2.02	P	P	P	1	1
Hilaria jamesii	0.00	80.00	0.00	0.00	0.00		P	P	P	P
TOTAL NATIVE PERENNIAL GRASSES (w)	0.4	100.0	2.0	0.4	2.0	P	P	P	1	1
NATIVE SUBSHRUBS										
Chrysothamnus depressus	0.00	20.00	0.00	0.00	0.00		P			
Chrysothamnus greenei	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Eriogonum aureum	0.00	40.00	0.00	0.00	0.00			P	P	
Gutierrezia sarothrae	0.00	40.00	0.00	0.00	0.00				P	P
Leptodactylon pungens	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE SUBSHRUBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	2.20	100.00	11.22	2.20	11.11	P	2	P	1	8
Atriplex canescens	0.00	20.00	0.00	0.00	0.00				P	
Chrysothamnus nauseosus	0.20	20.00	1.02	0.20	1.01		1			
Chrysothamnus viscidiflorus	0.00	80.00	0.00	0.00	0.00	P	P	P	P	
Ephedra viridis	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE SHRUBS	2.4	100.0	12.2	2.4	12.1	P	3	P	1	8

Table 10. Cover Data - J2 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE TREES										
Juniperus osteosperma	10.00	80.00	51.02	10.00	50.51	25	2	14	9	
Pinus edulis	6.60	80.00	33.67	6.60	33.33		12	14	1	6
TOTAL NATIVE TREES	16.6	100.0	84.7	16.6	83.8	25	14	28	10	6
SUCCULENT										
Mammillaria spp.	0.00	20.00	0.00	0.00	0.00				P	
TOTAL SUCCULENT	0.0	20.0	0.0	0.0	0.0	---	---	---	P	---
ALGAE										
Nostoc flagelliforme	0.00	20.00	0.00	0.00	0.00				P	
TOTAL ALGAE	0.0	20.0	0.0	0.0	0.0	---	---	---	P	---
Standing dead	4.00	100.00		4.00		4	5	1	1	9
Litter	16.40	100.00		16.40		26	13	15	14	14
Bare ground	51.40	100.00		51.40		44	62	55	59	37
Rock	8.60	100.00		8.60		1	3	1	13	25
TOTALS	100.0			100.2		100	100	100	100	100
TOTAL VEGETATION COVER	19.6 (s=6.5)		100.0	19.8 (s=6.8)	100.0	25(1)	17	28	13	15
GROUND COVER (Litter+Rock+Veg+St.Dead	48.6			48.8		56(1)	38	45	41	63
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 16.4 Std.Dev.= 5.0)						11	20	13	23	15

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 11. Cover Data - J4 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Gilia sinuata	0.00	20.00	0.00	0.00	0.00			P		
Linum puberulum	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	---	---	P	P	---
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00				P	
Eriogonum sp.	0.00	20.00	0.00	0.00	0.00	P				
Haplopappus nuttallii	0.00	20.00	0.00	0.00	0.00			P		
Oenothera coronopifolia	0.00	20.00	0.00	0.00	0.00			P		
Sphaeralcea coccinea	0.00	80.00	0.00	0.00	0.00	P		P	P	P
TOTAL NATIVE PERENNIAL FORBS	0.0	80.0	0.0	0.0	0.0	P	---	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.20	100.00	1.41	0.20	1.32	P	P	P	1	P
Sitanion longifolium	0.00	40.00	0.00	0.00	0.00			P	P	
Stipa comata	0.00	40.00	0.00	0.20	1.32				(1)	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	100.0	1.4	0.4	2.6	P	P	P	1(1)	P
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	20.00	0.00	0.00	0.00				P	
Bouteloua gracilis	0.60	100.00	4.23	0.60	3.95	P	P	1	2	P
Hilaria jamesii	0.60	100.00	4.23	1.20	7.89	1	P	(1)	2(2)	P
TOTAL NATIVE PERENNIAL GRASSES (w)	1.2	100.0	8.5	1.8	11.8	1	P	1(1)	4(2)	P
NATIVE SUBSHRUBS										
Chrysothamnus depressus	0.00	20.00	0.00	0.00	0.00				P	
Chrysothamnus greenei	0.00	60.00	0.00	0.00	0.00	P	P	P		
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00					P
Eurotia lanata	0.00	40.00	0.00	0.00	0.00	P			P	
Gutierrezia sarothrae	0.20	60.00	1.41	0.20	1.32	1			P	P
TOTAL NATIVE SUBSHRUBS	0.2	100.0	1.4	0.2	1.3	1	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	0.40	100.00	2.82	0.40	2.63	P	P	P	2	P
Atriplex canescens	0.00	20.00	0.00	0.00	0.00			P		
Chrysothamnus viscidiflorus	0.40	100.00	2.82	0.40	2.63	P	1	P	P	1
TOTAL NATIVE SHRUBS	0.8	100.0	5.6	0.8	5.3	P	1	P	2	1
NATIVE TREES										
Juniperus osteosperma	7.40	100.00	52.11	7.40	48.68	10	8	7	10	2
Pinus edulis	4.00	80.00	28.17	4.00	26.32		2	5	2	11
TOTAL NATIVE TREES	11.4	100.0	80.3	11.4	75.0	10	10	12	12	13
MOSS										
Moss	0.00	40.00	0.00	0.20	1.32	(1)				P
TOTAL MOSS	0.0	40.0	0.0	0.2	1.3	(1)	---	---	---	P
SUCCULENT										
Mammillaria spp.	0.00	20.00	0.00	0.00	0.00				P	
Opuntia macrorhiza	0.20	40.00	1.41	0.20	1.32		P		1	
Opuntia polyacantha	0.00	20.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.2	60.0	1.4	0.2	1.3	P	P	---	1	---

Table 11. Cover Data - J4 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	
AGAVOIDS										
Yucca angustissima	0.20	40.00	1.41	0.20	1.32		P			1
Yucca baccata	0.00	20.00	0.00	0.00	0.00			P		
TOTAL AGAVOIDS	0.2	60.0	1.4	0.2	1.3	---	P	P	---	1
Standing dead	2.40	80.00		2.40		2	1		5	4
Litter	13.20	100.00		13.20		5	14	26	13	8
Bare ground	53.60	100.00		53.60		80	65	38	40	45
Rock	16.60	100.00		16.60		1	9	23	22	28
TOTALS	100.0			101.0		100	100	100	100	100
TOTAL VEGETATION COVER	14.2 (s=3.6)		100.0	15.2 (s=4.6)	100.0	12(1)	11	13(1)	20(3)	15
GROUND COVER (Litter+Rock+Veg+St.Dead	46.4			47.4		20(1)	35	62(1)	60(3)	55
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 14.8 Std.Dev.= 3.3)						15	10	16	19	14

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 12. Cover Data - J8 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chenopodium fremontii	0.00	20.00	0.00	0.00	0.00	P				
Lappula redowskii	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	P	P	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Astragalus wingatanus	0.00	40.00	0.00	0.00	0.00			P	P	
Calochortus nuttallii	0.00	80.00	0.00	0.00	0.00	P	P	P	P	
Cymopterus purpurascens	0.00	80.00	0.00	0.00	0.00	P	P	P		P
Eriogonum sp.	0.00	20.00	0.00	0.00	0.00	P				
Sphaeralcea coccinea	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.00	20.00	0.00	0.00	0.00			P		
Oryzopsis hymenoides	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Sitanion longifolium	0.00	60.00	0.00	0.00	0.00	P			P	P
Stipa comata	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.00	60.00	0.00	0.00	0.00	P	P			P
Hilaria jamesii	0.60	100.00	4.41	0.60	4.29	P	1	1	P	1
TOTAL NATIVE PERENNIAL GRASSES (w)	0.6	100.0	4.4	0.6	4.3	P	1	1	P	1
NATIVE SUBSHRUBS										
Chrysothamnus depressus	0.00	40.00	0.00	0.00	0.00	P			P	
Chrysothamnus greenei	0.40	60.00	2.94	0.40	2.86		2		P	P
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00	P				
Gutierrezia sarothrae	0.00	60.00	0.00	0.00	0.00	P	P		P	
TOTAL NATIVE SUBSHRUBS	0.4	80.0	2.9	0.4	2.9	P	2	---	P	P
NATIVE SHRUBS										
Artemisia tridentata	1.80	80.00	13.24	2.00	14.29	3	1(1)		1	4
Atriplex canescens	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Chrysothamnus viscidiflorus	0.20	100.00	1.47	0.20	1.43	P	P	P	1	P
Lycium pallidum	0.00	40.00	0.00	0.00	0.00		P		P	
TOTAL NATIVE SHRUBS	2.0	100.0	14.7	2.2	15.7	3	1(1)	P	2	4
NATIVE TREES										
Juniperus osteosperma	7.00	100.00	51.47	7.00	50.00	5	11	5	7	7
Pinus edulis	3.60	60.00	26.47	3.80	27.14	11	6(1)			1
TOTAL NATIVE TREES	10.6	100.0	77.9	10.8	77.1	16	17(1)	5	7	8
MOSS										
Moss	0.00	40.00	0.00	0.00	0.00				P	P
TOTAL MOSS	0.0	40.0	0.0	0.0	0.0	---	---	---	P	P
SUCCULENT										
Opuntia macrorhiza	0.00	60.00	0.00	0.00	0.00	P	P			P
Opuntia whipplei	0.00	20.00	0.00	0.00	0.00				P	
TOTAL SUCCULENT	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P

Table 12. Cover Data - J8 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
Standing dead	5.40	100.00		5.40		4	9	6	5	3
Litter	11.80	100.00		11.80		11	10	15	22	1
Bare ground	49.80	100.00		49.80		36	56	42	50	65
Rock	19.40	100.00		19.40		30	4	31	14	18
TOTALS	100.0			100.4		100	100	100	100	100
TOTAL VEGETATION COVER	13.6 (s=6.4)		100.0	14.0 (s=7.0)	100.0	19	21(2)	6	9	13
GROUND COVER (Litter+Rock+Veg+St.Dead	50.2			50.6		64	44(2)	58	50	35
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.8 Std.Dev.= 3.0)						19	17	11	17	15

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 13. Cover Data - J10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Lupinus brevicaulus	0.00	20.00	0.00	0.00	0.00			P		
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
INTRODUCED ANNUAL & BIENNIAL FORBS										
Euphorbia sp.	0.00	20.00	0.00	0.00	0.00		P			
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.20	60.00	1.03	0.20	1.03		P	1		P
Cymopterus purpurascens	0.20	20.00	1.03	0.20	1.03		1			
Eriogonum umbellatum	0.00	40.00	0.00	0.00	0.00		P	P		
Haplopappus sp.	0.00	20.00	0.00	0.00	0.00					P
Mirabilis multiflora	0.00	20.00	0.00	0.00	0.00					P
Solidago petradoria	0.00	40.00	0.00	0.00	0.00			P	P	
Stanleya pinnata	0.00	40.00	0.00	0.00	0.00			P		P
TOTAL NATIVE PERENNIAL FORBS	0.4	80.0	2.1	0.4	2.1	---	1	1	P	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Stipa comata	0.00	40.00	0.00	0.00	0.00			P		P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	80.0	0.0	0.0	0.0	P	---	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.20	100.00	1.03	0.20	1.03	P	P	1	P	P
Hilaria jamesii	0.00	80.00	0.00	0.00	0.00		P	P	P	P
TOTAL NATIVE PERENNIAL GRASSES (w)	0.2	100.0	1.0	0.2	1.0	P	P	1	P	P
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.20	60.00	1.03	0.20	1.03		P	P		1
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00		P			
Eriogonum corymbosum	0.40	60.00	2.06	0.40	2.06			1	1	P
Gutierrezia sarothrae	0.00	80.00	0.00	0.00	0.00	P	P	P	P	
TOTAL NATIVE SUBSHRUBS	0.6	100.0	3.1	0.6	3.1	P	P	1	1	1
NATIVE SHRUBS										
Artemisia tridentata	0.80	80.00	4.12	0.80	4.12	1	P	2		1
Atriplex canescens	0.40	80.00	2.06	0.40	2.06	2	P		P	P
Cowania mexicana	0.20	20.00	1.03	0.20	1.03				1	
Ephedra viridis	0.00	20.00	0.00	0.00	0.00			P		
Lycium pallidum	0.00	20.00	0.00	0.00	0.00		P			
Shepherdia rotundifolia	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE SHRUBS	1.4	100.0	7.2	1.4	7.2	3	P	2	1	1
NATIVE TREES										
Juniperus osteosperma	7.00	80.00	36.08	7.00	36.08	14	8	5		8
Pinus edulis	9.80	100.00	50.52	9.80	50.52	16	8	2	2	21
TOTAL NATIVE TREES	16.8	100.0	86.6	16.8	86.6	30	16	7	2	29
MOSS										
Moss	0.00	20.00	0.00	0.00	0.00			P		
TOTAL MOSS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
LICHEN										
Parmelia chlorochroa	0.00	40.00	0.00	0.00	0.00			P		P
TOTAL LICHEN	0.0	40.0	0.0	0.0	0.0	---	---	P	---	P
SUCCULENT										
Opuntia macrorhiza	0.00	40.00	0.00	0.00	0.00			P	P	
TOTAL SUCCULENT	0.0	40.0	0.0	0.0	0.0	---	---	P	P	---

Table 13. Cover Data - J10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number- 1	2	3	4	
AGAVOIDS										
Yucca angustissima	0.00	20.00	0.00	0.00	0.00		P			
TOTAL AGAVOIDS	0.0	20.0	0.0	0.0	0.0	---	P	---	---	---
Standing dead	1.40	60.00		1.40		3		3		1
Litter	16.40	100.00		16.40		28	23	14	5	12
Bare ground	45.60	100.00		45.60		30	35	49	65	49
Rock	17.20	100.00		17.20		6	25	22	26	7
TOTALS	100.0			100.0		100	100	100	100	100
TOTAL VEGETATION COVER	19.4 (s=12.4)		100.0	19.4 (s=12.4)	100.0	33	17	12	4	31
GROUND COVER (Litter+Rock+Veg+St.Dead	54.4			54.4		70	65	51	35	51
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 13.4 Std.Dev.= 4.8)						7	15	19	10	16

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 14. Cover Data - J13/14 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Lappula redowskii	0.00	20.00	0.00	0.00	0.00	P				
Linum puberulum	0.00	20.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	40.0	0.0	0.0	0.0	P	P	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	60.00	0.00	0.00	0.00			P	P	P
Calochortus nuttallii	0.00	20.00	0.00	0.00	0.00				P	
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00					P
Oxybaphus linearis	0.00	20.00	0.00	0.00	0.00		P			
Phlox sp.	0.00	20.00	0.00	0.00	0.00	P				
Sphaeralcea coccinea	0.00	60.00	0.00	0.00	0.00		P	P	P	
Stephanomeria runcinata	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.20	100.00	1.72	0.20	1.69	1	P	P	P	P
Sitanion longifolium	0.00	20.00	0.00	0.00	0.00	P				
Stipa comata	0.00	60.00	0.00	0.00	0.00	P			P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	100.0	1.7	0.2	1.7	1	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	40.00	0.00	0.00	0.00		P			P
Bouteloua gracilis	0.60	100.00	5.17	0.80	6.78	1(1)	P	P	1	1
Hilaria jamesii	0.20	80.00	1.72	0.20	1.69	P	1		P	P
Sporobolus cryptandrus	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE PERENNIAL GRASSES (w)	0.8	100.0	6.9	1.0	8.5	1(1)	1	P	1	1
NATIVE SUBSHRUBS										
Chrysothamnus depressus	0.20	20.00	1.72	0.20	1.69					1
Chrysothamnus greenei	0.00	20.00	0.00	0.00	0.00					P
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00					P
Gutierrezia sarothrae	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Haplopappus drummondii	0.00	20.00	0.00	0.00	0.00		P			
Leptodactylon pungens	0.00	20.00	0.00	0.00	0.00					P
Polygala subspinosa	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE SUBSHRUBS	0.2	100.0	1.7	0.2	1.7	P	P	P	P	1
NATIVE SHRUBS										
Artemisia tridentata	0.40	40.00	3.45	0.40	3.39	1				1
Atriplex canescens	0.00	20.00	0.00	0.00	0.00		P			
Atriplex confertifolia	0.40	60.00	3.45	0.40	3.39		P		1	1
Chrysothamnus nauseosus	0.20	20.00	1.72	0.20	1.69					1
Chrysothamnus viscidiflorus	0.80	100.00	6.90	0.80	6.78	2	P	1	P	1
Lycium pallidum	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE SHRUBS	1.8	100.0	15.5	1.8	15.3	3	P	1	1	4
NATIVE TREES										
Juniperus osteosperma	5.20	100.00	44.83	5.20	44.07	7	3	4	4	8
Pinus edulis	3.20	60.00	27.59	3.20	27.12		7		9	P
TOTAL NATIVE TREES	8.4	100.0	72.4	8.4	71.2	7	10	4	13	8
MOSS										
Moss	0.00	20.00	0.00	0.00	0.00	P				
TOTAL MOSS	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
SUCCULENT										
Opuntia macrorhiza	0.20	100.00	1.72	0.20	1.69	1	P	P	P	P
Opuntia whipplei	0.00	20.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.2	100.0	1.7	0.2	1.7	1	P	P	P	P

Table 14. Cover Data - J13/14 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number--- 1	2	3	4	5
AGAVOIDS										
Yucca angustissima	0.00	40.00	0.00	0.00	0.00	P		P		
TOTAL AGAVOIDS	0.0	40.0	0.0	0.0	0.0	P	---	P	---	---
Standing dead	6.40	100.00		6.40		10	6	6	4	6
Litter	15.80	100.00		15.80		17	12	30	7	13
Bare ground	47.20	100.00		47.20		52	29	49	43	63
Rock	19.00	100.00		19.00		8	42	10	31	4
TOTALS	100.0			100.2		100	100	100	100	100
TOTAL VEGETATION COVER	11.6 (s=4.0)		100.0	11.8 (s=4.1)	100.0	13(1)	11	5	15	14
GROUND COVER (Litter+Rock+Veg+St.Dead	52.8			53.0		48(1)	71	51	57	37
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.2 Std.Dev.= 4.0)						18	16	9	14	19

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 15. Cover Data - J15 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Descurainia pinnata	0.00	20.00	0.00	0.00	0.00	P				
Lappula redowskii	0.00	20.00	0.00	0.00	0.00	P				
Linum puberulum	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	P	---	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Astragalus calycosus var. scapiosus	0.00	20.00	0.00	0.00	0.00					P
Astragalus wingatanus	0.00	20.00	0.00	0.00	0.00			P		
Cryptantha flavoculata	0.40	20.00	2.27	0.40	2.25	2				
Cryptantha sp.	0.00	40.00	0.00	0.00	0.00	P		P		
Cymopterus purpureus	0.00	40.00	0.00	0.00	0.00	P		P		
Eriogonum umbellatum	0.00	20.00	0.00	0.00	0.00	P				
Oxybaphus linearis	0.00	20.00	0.00	0.00	0.00					P
Sphaeralcea coccinea	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL FORBS	0.4	80.0	2.3	0.4	2.2	2	---	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Oryzopsis hymenoides	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Poa fendleriana	0.20	20.00	1.14	0.20	1.12				1	
Sitanion jubatum	0.00	40.00	0.00	0.00	0.00		P		P	
Sitanion longifolium	0.00	20.00	0.00	0.00	0.00					P
Stipa comata	0.00	40.00	0.00	0.00	0.00				P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.2	100.0	1.1	0.2	1.1	P	P	P	1	P
NATIVE PERENNIAL GRASSES (warm)										
Aristida purpurea	0.00	40.00	0.00	0.00	0.00	P			P	
Bouteloua gracilis	0.20	100.00	1.14	0.20	1.12	1	P	P	P	P
Hilaria jamesii	0.20	100.00	1.14	0.20	1.12	1	P	P	P	P
TOTAL NATIVE PERENNIAL GRASSES (w)	0.4	100.0	2.3	0.4	2.2	2	P	P	P	P
NATIVE SUBSHRUBS										
Eriogonum aureum	0.00	20.00	0.00	0.00	0.00					P
Gutierrezia sarothrae	0.00	80.00	0.00	0.00	0.00	P	P		P	P
Haplopappus drummondii	0.00	40.00	0.00	0.00	0.00	P	P			
TOTAL NATIVE SUBSHRUBS	0.0	80.0	0.0	0.0	0.0	P	P	---	P	P
NATIVE SHRUBS										
Artemisia tridentata	1.20	60.00	6.82	1.40	7.87		5		1	(1)
Chrysothamnus viscidiflorus	0.00	60.00	0.00	0.00	0.00	P	P		P	
Cowania mexicana	0.00	20.00	0.00	0.00	0.00			P		
Ephedra viridis	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE SHRUBS	1.2	100.0	6.8	1.4	7.9	P	5	P	1	(1)
NATIVE TREES										
Juniperus osteosperma	8.60	100.00	48.86	8.60	48.31	5	8	8	12	10
Pinus edulis	5.80	100.00	32.95	5.80	32.58	6	2	1	1	19
TOTAL NATIVE TREES	14.4	100.0	81.8	14.4	80.9	11	10	9	13	29
MOSS										
Moss	0.40	20.00	2.27	0.40	2.25	2				
Polytrichum piliferum	0.20	20.00	1.14	0.20	1.12					1
TOTAL MOSS	0.6	40.0	3.4	0.6	3.4	2	---	---	---	1
LICHEN										
Collema tenax	0.20	60.00	1.14	0.20	1.12	P	1			P
Lecidea decipiens	0.00	40.00	0.00	0.00	0.00	P				P
Lecidea sp.	0.20	20.00	1.14	0.20	1.12					1
TOTAL LICHEN	0.4	60.0	2.3	0.4	2.2	P	1	---	---	1

Table 15. Cover Data - J15 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
SUCCULENT										
Opuntia macrorhiza	0.00	60.00	0.00	0.00	0.00		P	P		P
Opuntia whipplei	0.00	20.00	0.00	0.00	0.00					P
TOTAL SUCCULENT	0.0	60.0	0.0	0.0	0.0	---	P	P	---	P
AGAVOIDS										
Yucca angustissima	0.00	20.00	0.00	0.00	0.00			P		
TOTAL AGAVOIDS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
Standing dead	0.80	80.00		0.80		1	1	1	1	
Litter	15.60	100.00		15.60		13	23	12	19	11
Bare ground	42.20	100.00		42.20		37	38	56	48	32
Rock	23.80	100.00		23.80		32	22	22	17	26
TOTALS	100.0			100.2		100	100	100	100	100
TOTAL VEGETATION COVER	17.6 (s=8.1)		100.0	17.8 (s=8.5)	100.0	17	16	9	15	31(1)
GROUND COVER (Litter+Rock+Veg+St.Dead	57.8			58.0		63	62	44	52	68(1)
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.6 Std.Dev.= 4.2)						21	12	12	14	19

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 16. Cover Data - J28 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Aster canescens	0.00	20.00	0.00	0.00	0.00	P				
Chenopodium berlandieri	0.00	20.00	0.00	0.00	0.00	P				
Chenopodium fremontii	0.00	20.00	0.00	0.00	0.00				P	
Chenopodium leptophyllum	0.00	40.00	0.00	0.00	0.00				P	P
Descurainia pinnata	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Descurainia richardsonii	0.00	20.00	0.00	0.00	0.00					P
Lappula redowskii	0.00	60.00	0.00	0.00	0.00	P			P	P
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	80.0	0.0	0.0	0.0	P	---	P	P	P
INTRODUCED ANNUAL & BIENNIAL FORBS										
Chenopodium album	0.00	20.00	0.00	0.00	0.00					P
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
NATIVE ANNUAL GRASSES										
Festuca octoflora	0.00	20.00	0.00	0.00	0.00					P
TOTAL NATIVE ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	20.00	0.00	0.00	0.00					P
TOTAL INTRO. ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
NATIVE PERENNIAL FORBS										
Arabis lignifera	0.00	20.00	0.00	0.00	0.00					P
Aster arenosus	0.00	40.00	0.00	0.00	0.00		P		P	
Astragalus wingatanus	0.00	40.00	0.00	0.00	0.00	P			P	
Cryptantha flavoculata	0.00	40.00	0.00	0.00	0.00				P	P
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00	P				
Euphorbia fendleri	0.00	20.00	0.00	0.00	0.00	P				
Lesquerella intermedia	0.00	20.00	0.00	0.00	0.00	P				
Mirabilis multiflora	0.00	20.00	0.00	0.00	0.00				P	
Mirabilis oxybaphoides	0.00	20.00	0.00	0.00	0.00				P	
Oxybaphus linearis	0.00	20.00	0.00	0.00	0.00		P			
Pedicularis centrantherum	0.00	40.00	0.00	0.00	0.00	P		P		
Penstemon barbatus	0.00	20.00	0.00	0.00	0.00			P		
Penstemon linarioides	0.00	20.00	0.00	0.00	0.00	P				
Phlox longifolia	0.00	20.00	0.00	0.00	0.00	P				
Solidago petradoria	0.00	20.00	0.00	0.00	0.00	P				
Sphaeralcea coccinea	0.00	60.00	0.00	0.00	0.00	P	P		P	
Sphaeralcea parvifolia	0.00	20.00	0.00	0.00	0.00		P			
Townsendia exscapa	0.00	60.00	0.00	0.00	0.00	P		P	P	
TOTAL NATIVE PERENNIAL FORBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)										
Agropyron smithii	0.00	20.00	0.00	0.00	0.00			P		
Oryzopsis hymenoides	0.00	100.00	0.00	0.00	0.00	P	P	P	P	P
Poa fendleriana	0.00	40.00	0.00	0.00	0.00	P		P		
Sitanion jubatum	0.00	60.00	0.00	0.00	0.00	P		P	P	
Sitanion longifolium	0.00	40.00	0.00	0.00	0.00		P			P
Stipa comata	0.00	20.00	0.00	0.00	0.00			P		
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.00	80.00	0.00	0.00	0.00		P	P	P	P
Hilaria jamesii	0.20	60.00	0.98	0.20	0.95	1			P	P
Sporobolus cryptandrus	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL GRASSES (w)	0.2	100.0	1.0	0.2	1.0	1	P	P	P	P

Table 16. Cover Data - J28 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number- 1	2	3	4	
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.00	20.00	0.00	0.00	0.00		P			
Eriogonum aureum	0.00	40.00	0.00	0.00	0.00			P		P
Gutierrezia sarothrae	0.00	80.00	0.00	0.00	0.00	P		P	P	P
Senecio douglasii var. longilobus	0.00	20.00	0.00	0.00	0.00	P				
TOTAL NATIVE SUBSHRUBS	0.0	100.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	2.00	100.00	9.80	2.20	10.48	1	1	1	P	7(1)
Atriplex canescens	0.40	20.00	1.96	0.40	1.90		2			
Chrysothamnus nauseosus	0.20	20.00	0.98	0.20	0.95	1				
Chrysothamnus viscidiflorus	0.00	20.00	0.00	0.20	0.95		(1)			
Cowania mexicana	0.20	20.00	0.98	0.20	0.95	1				
Haplopappus laricifolius	0.20	60.00	0.98	0.20	0.95	1	P	P		
Lycium pallidum	0.00	20.00	0.00	0.00	0.00				P	
TOTAL NATIVE SHRUBS	3.0	100.0	14.7	3.4	16.2	4	3(1)	1	P	7(1)
NATIVE TREES										
Juniperus osteosperma	6.20	100.00	30.39	6.40	30.48	7	4	9(1)	P	11
Pinus edulis	11.00	60.00	53.92	11.00	52.38		7	22	26	
TOTAL NATIVE TREES	17.2	100.0	84.3	17.4	82.9	7	11	31(1)	26	11
MOSS										
Polytrichum piliferum	0.00	40.00	0.00	0.00	0.00			P	P	
TOTAL MOSS	0.0	40.0	0.0	0.0	0.0	---	---	P	P	---
SUCCULENT										
Echinocereus triglochidiatus var. mojavensis	0.00	20.00	0.00	0.00	0.00					P
Opuntia phaeacantha	0.00	20.00	0.00	0.00	0.00					
Pediocactus simpsonii	0.00	20.00	0.00	0.00	0.00			P		
TOTAL SUCCULENT	0.0	40.0	0.0	0.0	0.0	---	---	P	---	P
AGAVOIDS										
Yucca angustissima	0.00	20.00	0.00	0.00	0.00			P		
TOTAL AGAVOIDS	0.0	20.0	0.0	0.0	0.0	---	---	P	---	---
Standing dead	2.80	60.00		2.80		5	1			8
Litter	24.20	100.00		24.20		26	17	23	36	19
Bare ground	45.80	100.00		45.80		50	57	42	28	52
Rock	6.80	100.00		6.80		7	11	3	10	3
TOTALS	100.0			100.6		100	100	100	100	100
TOTAL VEGETATION COVER	20.4 (s=8.4)		100.0	21.0 (s=8.5)	100.0	12	14(1)	32(1)	26	18(1)
GROUND COVER (Litter+Rock+Veg+St.Dead	54.2			54.8		50	43(1)	58(1)	72	48(1)
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 19.8 Std.Dev.= 4.1)						25	14	19	22	19

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 17. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chenopodium fremontii	0.00	10.00	0.00	0.00	0.00					
Descurainia pinnata	0.00	20.00	0.00	0.00	0.00					
Lappula redowskii	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	30.0	0.0	0.0	0.0	---	---	---	---	---
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	10.00	0.00	0.00	0.00					
TOTAL INTRO. ANN. GRASSES	0.0	10.0	0.0	0.0	0.0	---	---	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.00	50.00	0.00	0.00	0.00	P		P	P	
Astragalus wingatanus	0.00	20.00	0.00	0.00	0.00					
Cryptantha flavoculata	0.00	10.00	0.00	0.00	0.00					
Cryptantha sp.	0.00	10.00	0.00	0.00	0.00		P			
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00					
Eriogonum umbellatum	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	30.00	0.00	0.00	0.00		P	P		
Mirabilis multiflora	0.00	10.00	0.00	0.00	0.00					
Pedicularis centrantherum	0.00	30.00	0.00	0.00	0.00					
Penstemon linarioides	0.00	30.00	0.00	0.00	0.00					
Psilostrophe sparsiflora	0.00	10.00	0.00	0.00	0.00		P			
Solidago petradoria	0.00	30.00	0.00	0.10	0.59	P				
Stanleya pinnata	0.00	20.00	0.00	0.00	0.00	P				
Streptanthus cordatus	0.00	10.00	0.00	0.00	0.00				P	
TOTAL NATIVE PERENNIAL FORBS	0.0	90.0	0.0	0.1	0.6	P	P	P	P	---
NATIVE PERENNIAL GRASSES (cool)										
Carex occidentalis	0.00	10.00	0.00	0.00	0.00			P		
Oryzopsis hymenoides	0.00	70.00	0.00	0.00	0.00	P	P	P	P	
Poa fendleriana	0.00	10.00	0.00	0.00	0.00					
Sitanion longifolium	0.00	40.00	0.00	0.00	0.00		P			
Stipa comata	0.00	10.00	0.00	0.00	0.00			P		
TOTAL NATIVE PERENNIAL GRASSES (c)	0.0	80.0	0.0	0.0	0.0	P	P	P	P	---
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.20	60.00	1.22	0.20	1.18	P	1	P		1
Hilaria jamesii	0.00	40.00	0.00	0.00	0.00	P		P		
TOTAL NATIVE PERENNIAL GRASSES (w)	0.2	60.0	1.2	0.2	1.2	P	1	P	---	1
NATIVE SUBSHRUBS										
Artemisia frigida	0.00	10.00	0.00	0.00	0.00					
Eriogonum aureum	0.00	10.00	0.00	0.00	0.00					
Eriogonum corymbosum	0.00	10.00	0.00	0.00	0.00		P			
Gutierrezia sarothrae	0.10	80.00	0.61	0.10	0.59	P	P	P		1
TOTAL NATIVE SUBSHRUBS	0.1	90.0	0.6	0.1	0.6	P	P	P	---	1
NATIVE SHRUBS										
Artemisia tridentata	0.40	40.00	2.44	0.40	2.35	1	P		1	2
Atriplex canescens	0.10	10.00	0.61	0.10	0.59	1				
Chrysothamnus viscidiflorus	0.00	30.00	0.00	0.00	0.00	P				
Cowania mexicana	1.20	70.00	7.32	1.30	7.65		2	2		1
Ephedra viridis	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE SHRUBS	1.7	90.0	10.4	1.8	10.6	2	2	2	1	3
NATIVE TREES										
Juniperus osteosperma	6.10	100.00	37.20	6.30	37.06	1	6	9	9	1
Pinus edulis	7.90	100.00	48.17	8.00	47.06	8	2	4	10	5
TOTAL NATIVE TREES	14.0	100.0	85.4	14.3	84.1	9	8	13	19	6

Table 17. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
MOSS										
Moss	0.10	40.00	0.61	0.10	0.59	P		P		1
Polytrichum piliferum	0.00	30.00	0.00	0.10	0.59					
TOTAL MOSS	0.1	70.0	0.6	0.2	1.2	P	---	P	---	1
LICHEN										
Lecidea sp.	0.10	10.00	0.61	0.10	0.59					
Parmelia chlorochroa	0.10	20.00	0.61	0.10	0.59	1				
TOTAL LICHEN	0.2	30.0	1.2	0.2	1.2	1	---	---	---	---
SUCCULENT										
Mammilaria microcarpa	0.00	10.00	0.00	0.00	0.00			P		
Opuntia macrorhiza	0.00	20.00	0.00	0.00	0.00	P		P		
Opuntia polyacantha	0.10	10.00	0.61	0.10	0.59					
Pediocactus simpsonii	0.00	10.00	0.00	0.00	0.00	P				
TOTAL SUCCULENT	0.1	30.0	0.6	0.1	0.6	P	---	P	---	---
AGAVOIDS										
Yucca angustissima	0.00	10.00	0.00	0.00	0.00		P			
TOTAL AGAVOIDS	0.0	10.0	0.0	0.0	0.0	---	P	---	---	---
Standing dead	2.90	70.00		2.90		5	1	7	5	3
Litter	20.00	100.00		20.00		16	14	22	31	9
Bare ground	40.60	100.00		40.60		29	56	36	34	34
Rock	20.10	100.00		20.10		38	18	20	10	42
TOTALS	100.0			100.6		100	100	100	100	100
TOTAL VEGETATION COVER	16.4 (s=5.4)		100.0	17.0 (s=5.5)	100.0	12	11	15	20	12
GROUND COVER (Litter+Rock+Veg+St.Dead	59.4			60.0		71	44	64	66	66
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 12.2 Std.Dev.= 3.6)						16	14	14	6	7

Table 17. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

Percent Foliar Cover*

PLANT SPECIES	----Sample Number----				
	6	7	8	9	10
NATIVE ANNUAL & BIENNIAL FORBS					
Chenopodium fremontii		P			
Descurainia pinnata	P		P		
Lappula redowskii			P		
TOTAL NATIVE ANN. & BIEN. FORBS	P	P	P	---	---
INTRODUCED ANNUAL GRASSES					
Bromus tectorum			P		
TOTAL INTRO. ANN. GRASSES	---	---	P	---	---
NATIVE PERENNIAL FORBS					
Aster arenosus		P		P	
Astragalus wingatanus	P		P		
Cryptantha flavoculata			P		
Cryptantha sp.					
Cymopterus purpurascens			P		P
Eriogonum umbellatum				P	
Euphorbia fendleri		P			
Mirabilis multiflora		P			
Pedicularis centrantherum	P		P		P
Penstemon linarioides	P		P		P
Psilostrophe sparsiflora					
Solidago petradoria				P	(1)
Stanleya pinnata		P			
Streptanthus cordatus					
TOTAL NATIVE PERENNIAL FORBS	P	P	P	P	(1)
NATIVE PERENNIAL GRASSES (cool)					
Carex occidentalis					
Oryzopsis hymenoides	P	P			P
Poa fendleriana					P
Sitanion longifolium	P	P	P		
Stipa comata					
TOTAL NATIVE PERENNIAL GRASSES (c)	P	P	P	---	P
NATIVE PERENNIAL GRASSES (warm)					
Bouteloua gracilis		P			P
Hilaria jamesii		P			P
TOTAL NATIVE PERENNIAL GRASSES (w)	---	P	---	---	P
NATIVE SUBSHRUBS					
Artemisia frigida				P	
Eriogonum aureum		P			
Eriogonum corymbosum					
Gutierrezia sarothrae	P		P	P	P
TOTAL NATIVE SUBSHRUBS	P	P	P	P	P
NATIVE SHRUBS					
Artemisia tridentata					
Atriplex canescens					
Chrysothamnus viscidiflorus		P	P		
Cowania mexicana	2	2	2(1)	1	
Ephedra viridis				P	
TOTAL NATIVE SHRUBS	2	2	2(1)	1	---
NATIVE TREES					
Juniperus osteosperma	14	2(2)	4	8	7
Pinus edulis	10	7	14(1)	11	8
TOTAL NATIVE TREES	24	9(2)	18(1)	19	15

Table 17. Cover Data - N12/N99 NORTH/SOUTH LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

Percent Foliar Cover*

PLANT SPECIES	----Sample Number----				
	6	7	8	9	10
MOSS					
Moss		P			
Polytrichum piliferum	P		(1)		P
TOTAL MOSS	P	P	(1)	---	P
LICHEN					
Lecidea sp.	1				
Parmelia chlorochroa				P	
TOTAL LICHEN	1	---	---	P	---
SUCCULENT					
Mammilaria microcarpa					
Opuntia macrorhiza					
Opuntia polyacantha			1		
Pediocactus simpsonii					
TOTAL SUCCULENT	---	---	1	---	---
AGAVOIDS					
Yucca angustissima					
TOTAL AGAVOIDS	---	---	---	---	---
Standing dead		3		5	
Litter	28	19	29	15	17
Bare ground	40	47	38	46	46
Rock	5	20	12	14	22
TOTALS	100	100	100	100	100
TOTAL VEGETATION COVER	27	11(2)	21(3)	20	15(1)
GROUND COVER (Litter+Rock+Veg+St.Dead	60	53(2)	62(3)	54	54(1)
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 12.2 Std.Dev.= 3.6)	12	15	16	10	12

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 18. Cover Data - N9 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chenopodium fremontii	0.00	30.00	0.00	0.00	0.00	P	P			
Cryptantha crassisepala	0.00	20.00	0.00	0.00	0.00				P	
Descurainia pinnata	0.00	40.00	0.00	0.00	0.00			P		P
Descurainia richardsonii	0.00	10.00	0.00	0.00	0.00				P	
Draba cuneifolia	0.00	10.00	0.00	0.00	0.00					P
Draba reptans	0.00	30.00	0.00	0.00	0.00				P	
Gilia aggregata	0.00	50.00	0.00	0.00	0.00			P	P	
Gilia sp.	0.00	10.00	0.00	0.00	0.00					P
Lappula redowskii	0.00	30.00	0.00	0.00	0.00			P		P
Phacelia crenulata	0.00	10.00	0.00	0.00	0.00		P			
TOTAL NATIVE ANN. & BIEN. FORBS	0.0	90.0	0.0	0.0	0.0	P	P	P	P	P
INTRODUCED ANNUAL & BIENNIAL FORBS										
Chenopodium album	0.00	10.00	0.00	0.00	0.00					P
Chenopodium sp.	0.00	10.00	0.00	0.00	0.00					
TOTAL INTRO. ANN. & BIEN. FORBS	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	20.00	0.00	0.00	0.00					P
TOTAL INTRO. ANN. GRASSES	0.0	20.0	0.0	0.0	0.0	---	---	---	---	P
NATIVE PERENNIAL FORBS										
Arabis lignifera	0.00	30.00	0.00	0.00	0.00			P	P	
Asclepias asperula	0.00	10.00	0.00	0.00	0.00		P			
Aster arenosus	0.00	60.00	0.00	0.00	0.00	P	P		P	
Astragalus wingatanus	0.10	60.00	0.45	0.10	0.44	P		P		
Cryptantha sp.	0.00	10.00	0.00	0.00	0.00					
Cymopterus purpurascens	0.10	20.00	0.45	0.10	0.44	P				
Eriogonum alatum	0.00	20.00	0.00	0.00	0.00	P	P			
Eriogonum sp.	0.00	30.00	0.00	0.00	0.00	P				
Eriogonum umbellatum	0.00	20.00	0.00	0.00	0.00		P			
Euphorbia fendleri	0.00	10.00	0.00	0.00	0.00	P				
Haplopappus armerioides	0.10	10.00	0.45	0.10	0.44				1	
Haplopappus nuttallii	0.00	20.00	0.00	0.00	0.00					
Lygodesmia juncea	0.00	10.00	0.00	0.00	0.00					P
Mirabilis multiflora	0.00	10.00	0.00	0.00	0.00		P			
Pedicularis centrantherum	0.00	50.00	0.00	0.00	0.00	P			P	P
Penstemon barbatus	0.00	20.00	0.00	0.00	0.00				P	
Penstemon eatoni	0.00	20.00	0.00	0.00	0.00	P				
Penstemon linarioides	0.00	70.00	0.00	0.00	0.00	P		P	P	
Psilostrophe sparsiflora	0.00	10.00	0.00	0.00	0.00					
Solidago petradoria	0.00	10.00	0.00	0.00	0.00					
Sphaeralcea coccinea	0.00	10.00	0.00	0.00	0.00		P			
Stanleya pinnata	0.00	30.00	0.00	0.00	0.00					
Streptanthus cordatus	0.00	30.00	0.00	0.00	0.00				P	P
Townsendia sp.	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE PERENNIAL FORBS	0.3	100.0	1.4	0.3	1.3	P	P	P	1	P
NATIVE PERENNIAL GRASSES (cool)										
Carex occidentalis	0.00	10.00	0.00	0.00	0.00					
Oryzopsis hymenoides	0.10	90.00	0.45	0.10	0.44	1	P	P	P	P
Poa fendleriana	0.00	40.00	0.00	0.00	0.00			P		
Sitanion longifolium	0.00	90.00	0.00	0.00	0.00		P	P	P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	0.1	100.0	0.5	0.1	0.4	1	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.00	40.00	0.00	0.00	0.00	P		P		
Hilaria jamesii	0.00	70.00	0.00	0.00	0.00	P	P	P	P	
TOTAL NATIVE PERENNIAL GRASSES (w)	0.0	70.0	0.0	0.0	0.0	P	P	P	P	---

Table 18. Cover Data - N9 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number-- 1	2	3	4	
NATIVE SUBSHRUBS										
Eriogonum aureum	0.00	10.00	0.00	0.00	0.00					
Gutierrezia sarothrae	0.00	90.00	0.00	0.00	0.00	P	P	P	P	P
TOTAL NATIVE SUBSHRUBS	0.0	90.0	0.0	0.0	0.0	P	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	1.00	60.00	4.55	1.30	5.78		P	4(3)		
Atriplex canescens	0.10	10.00	0.45	0.10	0.44		1			
Chrysothamnus nauseosus	0.10	10.00	0.45	0.10	0.44					
Chrysothamnus viscidiflorus	0.00	20.00	0.00	0.00	0.00		P			P
Cowania mexicana	1.30	70.00	5.91	1.40	6.22	P			1(1)	5
Ephedra viridis	0.00	50.00	0.00	0.00	0.00			P	P	
Purshia tridentata	0.00	10.00	0.00	0.00	0.00					
Shepherdia rotundifolia	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE SHRUBS	2.5	100.0	11.4	2.9	12.9	P	1	4(3)	1(1)	5
NATIVE TREES										
Juniperus osteosperma	8.00	100.00	36.36	8.00	35.56	4	12	12	2	12
Pinus edulis	10.80	100.00	49.09	10.90	48.44	14	9	6	23	6
Quercus gambelii	0.00	10.00	0.00	0.00	0.00				P	
TOTAL NATIVE TREES	18.8	100.0	85.5	18.9	84.0	18	21	18	25	18
MOSS										
Moss	0.30	40.00	1.36	0.30	1.33			1	P	
TOTAL MOSS	0.3	40.0	1.4	0.3	1.3	---	---	1	P	---
LICHEN										
Lichen	0.00	20.00	0.00	0.00	0.00				P	
TOTAL LICHEN	0.0	20.0	0.0	0.0	0.0	---	---	---	P	
SUCCULENT										
Mammillaria sp.	0.00	10.00	0.00	0.00	0.00					
Opuntia macrorhiza	0.00	10.00	0.00	0.00	0.00					P
Opuntia polyacantha	0.00	50.00	0.00	0.00	0.00	P				P
TOTAL SUCCULENT	0.0	60.0	0.0	0.0	0.0	P	---	---	---	P
PARASITE										
Arceuthobium campylopodum	0.00	10.00	0.00	0.00	0.00					
TOTAL PARASITE	0.0	10.0	0.0	0.0	0.0	---	---	---	---	---
Standing dead	4.30	100.00		4.30		6	2	9	4	3
Litter	12.60	100.00		12.60		5	8	19	13	6
Bare ground	47.40	100.00		47.40		53	41	48	38	54
Rock	13.70	100.00		13.70		17	27	1	18	14
TOTALS	100.0			100.5		100	100	100	100	100
TOTAL VEGETATION COVER	22.0 (s=5.8)		100.0	22.5 (s=5.9)	100.0	19	22	23(3)	27(1)	23
GROUND COVER (Litter+Rock+Veg+St.Dead	52.6			53.1		47	59	52(3)	62(1)	46
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 18.9 Std.Dev.= 5.3)						18	17	17	22	18

Table 18. Cover Data - N9 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	Percent Foliar Cover* ----Sample Number---- 6	7	8	9	10
NATIVE ANNUAL & BIENNIAL FORBS					
Chenopodium fremontii			P		
Cryptantha crassisepala		P			
Descurainia pinnata		P	P		
Descurainia richardsonii					
Draba cuneifolia					
Draba reptans		P		P	
Gilia aggregata	P	P		P	
Gilia sp.					
Lappula redowskii	P				
Phacelia crenulata					
TOTAL NATIVE ANN. & BIEN. FORBS	P	P	P	P	---
INTRODUCED ANNUAL & BIENNIAL FORBS					
Chenopodium album					
Chenopodium sp.		P			
TOTAL INTRO. ANN. & BIEN. FORBS	---	P	---	---	---
INTRODUCED ANNUAL GRASSES					
Bromus tectorum	P				
TOTAL INTRO. ANN. GRASSES	P	---	---	---	---
NATIVE PERENNIAL FORBS					
Arabis lignifera		P			
Asclepias asperula					
Aster arenosus	P			P	P
Astragalus wingatanus	1	P	P	P	
Cryptantha sp.		P			
Cymopterus purpurascens	1				
Eriogonum alatum					
Eriogonum sp.		P		P	
Eriogonum umbellatum			P		
Euphorbia fendleri					
Haplopappus armerioides					
Haplopappus nuttallii	P			P	
Lygodesmia juncea					
Mirabilis multiflora					
Pedicularis centrantherum		P		P	
Penstemon barbatus				P	
Penstemon eatoni		P			
Penstemon linarioides	P	P	P	P	
Psilostrophe sparsiflora				P	
Solidago petradoria				P	
Sphaeralcea coccinea					
Stanleya pinnata	P	P			P
Streptanthus cordatus		P			
Townsendia sp.				P	
TOTAL NATIVE PERENNIAL FORBS	2	P	P	P	P
NATIVE PERENNIAL GRASSES (cool)					
Carex occidentalis		P			
Oryzopsis hymenoides	P	P	P	P	
Poa fendleriana	P	P		P	
Sitanion longifolium	P	P	P	P	P
TOTAL NATIVE PERENNIAL GRASSES (c)	P	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)					
Bouteloua gracilis	P			P	
Hilaria jamesii	P		P	P	
TOTAL NATIVE PERENNIAL GRASSES (w)	P	---	P	P	---

Table 18. Cover Data - N9 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	Percent Foliar Cover* ----Sample Number---- 6	7	8	9	10
NATIVE SUBSHRUBS					
Eriogonum aureum				P	
Gutierrezia sarothrae	P	P	P	P	
TOTAL NATIVE SUBSHRUBS	P	P	P	P	---
NATIVE SHRUBS					
Artemisia tridentata	3	P	1	2	
Atriplex canescens					
Chrysothamnus nauseosus			1		
Chrysothamnus viscidiflorus					
Cowania mexicana	2	1	1		3
Ephedra viridis	P	P			P
Purshia tridentata					P
Shepherdia rotundifolia		P			
TOTAL NATIVE SHRUBS	5	1	3	2	3
NATIVE TREES					
Juniperus osteosperma	7	14	6	5	6
Pinus edulis	1	15	10(1)	5	19
Quercus gambelii					
TOTAL NATIVE TREES	8	29	16(1)	10	25
MOSS					
Moss	1	1			
TOTAL MOSS	1	1	---	---	---
LICHEN					
Lichen		P			
TOTAL LICHEN	---	P	---	---	---
SUCCULENT					
Mammillaria sp.				P	
Opuntia macrorhiza					
Opuntia polyacantha	P	P			P
TOTAL SUCCULENT	P	P	---	P	P
PARASITE					
Arceuthobium campylopodum	P				
TOTAL PARASITE	P	---	---	---	---
Standing dead	5	6	1	6	1
Litter	12	19	9	17	18
Bare ground	65	24	52	63	36
Rock	2	20	19	2	17
TOTALS	100	100	100	100	100
TOTAL VEGETATION COVER	16	31	19(1)	12	28
GROUND COVER (Litter+Rock+Veg+St.Dead	35	76	48(1)	37	64
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 18.9 Std.Dev.= 5.3)	23	28	14	23	9

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 19. Cover Data - N10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	5
NATIVE ANNUAL & BIENNIAL FORBS										
Chaenactis stevioides	0.00	10.00	0.00	0.00	0.00					
Chenopodium fremontii	0.00	70.00	0.00	0.00	0.00	P	P		P	P
Descurainia pinnata	0.00	20.00	0.00	0.00	0.00	P				
Erysimum asperum	0.00	10.00	0.00	0.00	0.00					
Gilia sinuata	0.10	10.00	0.71	0.10	0.69					
Lappula redowskii	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE ANN. & BIEN. FORBS	0.1	80.0	0.7	0.1	0.7	P	P	---	P	P
INTRODUCED ANNUAL GRASSES										
Bromus tectorum	0.00	10.00	0.00	0.10	0.69					
TOTAL INTRO. ANN. GRASSES	0.0	10.0	0.0	0.1	0.7	---	---	---	---	---
NATIVE PERENNIAL FORBS										
Aster arenosus	0.10	40.00	0.71	0.20	1.38				P	P
Astragalus calycosus var. scapiosus	0.00	10.00	0.00	0.00	0.00					
Astragalus wingatanus	0.10	20.00	0.71	0.10	0.69					
Calochortus nuttallii	0.00	10.00	0.00	0.00	0.00					P
Cryptantha sp.	0.00	10.00	0.00	0.00	0.00					
Cymopterus purpurascens	0.00	20.00	0.00	0.00	0.00				P	
Eriogonum alatum	0.00	30.00	0.00	0.00	0.00			P	P	
Eriogonum umbellatum	0.00	10.00	0.00	0.00	0.00					P
Haplopappus nuttallii	0.00	20.00	0.00	0.00	0.00			P		
Lithospermum incisum	0.00	10.00	0.00	0.00	0.00					
Mirabilis multiflora	0.10	40.00	0.71	0.10	0.69				P	
Oxybaphus linearis	0.00	10.00	0.00	0.00	0.00		P			
Pedicularis centrantherum	0.00	20.00	0.00	0.00	0.00			P		
Penstemon barbatus	0.00	20.00	0.00	0.00	0.00			P		
Penstemon linarioides	0.00	40.00	0.00	0.00	0.00	P		P		
Solidago petradoria	0.10	30.00	0.71	0.10	0.69			P		1
Sphaeralcea coccinea	0.00	20.00	0.00	0.00	0.00				P	
Stanleya pinnata	0.00	20.00	0.00	0.00	0.00			P		
Streptanthus cordatus	0.00	10.00	0.00	0.00	0.00			P		
TOTAL NATIVE PERENNIAL FORBS	0.4	100.0	2.9	0.5	3.4	P	P	P	P	1
NATIVE PERENNIAL GRASSES (cool)										
Carex occidentalis	0.00	10.00	0.00	0.00	0.00			P		
Oryzopsis hymenoides	0.20	80.00	1.43	0.20	1.38		P	P	P	P
Poa fendleriana	0.00	20.00	0.00	0.00	0.00		P	P		
Sitanion longifolium	0.10	60.00	0.71	0.10	0.69			P	P	
Stipa comata	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE PERENNIAL GRASSES (c)	0.3	90.0	2.1	0.3	2.1	---	P	P	P	P
NATIVE PERENNIAL GRASSES (warm)										
Bouteloua gracilis	0.10	50.00	0.71	0.10	0.69		P		P	
Hilaria jamesii	0.30	30.00	2.14	0.50	3.45			P	1	
TOTAL NATIVE PERENNIAL GRASSES (w)	0.4	60.0	2.9	0.6	4.1	---	P	P	1	---
NATIVE SUBSHRUBS										
Chrysothamnus greenei	0.00	10.00	0.00	0.00	0.00				P	
Eriogonum microthecum	0.00	10.00	0.00	0.00	0.00					
Gutierrezia sarothrae	0.10	90.00	0.71	0.10	0.69		P	P	P	P
TOTAL NATIVE SUBSHRUBS	0.1	90.0	0.7	0.1	0.7	---	P	P	P	P
NATIVE SHRUBS										
Artemisia tridentata	0.80	70.00	5.71	0.90	6.21		2(1)	P	P	
Atriplex canescens	0.00	40.00	0.00	0.00	0.00				P	
Chrysothamnus viscidiflorus	0.00	50.00	0.00	0.00	0.00			P	P	
Cowania mexicana	1.20	60.00	8.57	1.20	8.28	7		2		P
Ephedra viridis	0.00	30.00	0.00	0.00	0.00	P				
Haplopappus laricifolius	0.00	10.00	0.00	0.00	0.00					
TOTAL NATIVE SHRUBS	2.0	100.0	14.3	2.1	14.5	7	2(1)	2	P	P

Table 19. Cover Data - N10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE COVER (%)	FREQUENCY (%)	RELATIVE VEGETATION COVER (%)	AVERAGE COVER-ALL (%)	RELATIVE VEGETATION COVER-ALL (%)	Percent Foliar Cover* ----Sample Number---- 1	2	3	4	
NATIVE TREES										
Juniperus osteosperma	6.20	100.00	44.29	6.20	42.76	8	7	3	15	1
Pinus edulis	3.90	100.00	27.86	3.90	26.90	3	2	8	3	4
Quercus gambelii	0.30	10.00	2.14	0.30	2.07					
TOTAL NATIVE TREES	10.4	100.0	74.3	10.4	71.7	11	9	11	18	5
MOSS										
Moss	0.00	30.00	0.00	0.00	0.00	P		P		
TOTAL MOSS	0.0	30.0	0.0	0.0	0.0	P	---	P	---	---
LICHEN										
Parmelia chlorochroa	0.00	40.00	0.00	0.00	0.00		P		P	
TOTAL LICHEN	0.0	40.0	0.0	0.0	0.0	---	P	---	P	---
SUCCULENT										
Echinocereus triglochidiatus var. mojavensis	0.00	30.00	0.00	0.00	0.00				P	
Opuntia polyacantha	0.20	50.00	1.43	0.20	1.38	P	1			P
TOTAL SUCCULENT	0.2	80.0	1.4	0.2	1.4	P	1	---	P	P
AGAVOIDS										
Yucca angustissima	0.00	10.00	0.00	0.00	0.00					P
Yucca baccata	0.10	40.00	0.71	0.10	0.69				P	
TOTAL AGAVOIDS	0.1	50.0	0.7	0.1	0.7	---	---	---	P	P
Standing dead	3.60	90.00		3.60		2	4	2	2	2
Litter	13.10	100.00		13.10		7	10	29	8	6
Bare ground	44.60	100.00		44.60		59	38	39	39	36
Rock	24.70	90.00		24.70		14	36	17	32	50
TOTALS	100.0			100.5		100	100	100	100	100
TOTAL VEGETATION COVER	14.0 (s=6.1)		100.0	14.5 (s=6.2)	100.0	18	12(1)	13	19	6
GROUND COVER (Litter+Rock+Veg+St.Dead	55.4			55.9		41	62(1)	61	61	64
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.7 Std.Dev.= 5.3)						9	11	20	20	12

Table 19. Cover Data - N10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

Percent Foliar Cover*

PLANT SPECIES	----Sample Number----				
	6	7	8	9	10
NATIVE ANNUAL & BIENNIAL FORBS					
Chaenactis stevioides			P		
Chenopodium fremontii	P	P			P
Descurainia pinnata			P		
Erysimum asperum			P		
Gilia sinuata			1		
Lappula redowskii			P		
TOTAL NATIVE ANN. & BIEN. FORBS	P	P	1	---	P
INTRODUCED ANNUAL GRASSES					
Bromus tectorum			(1)		
TOTAL INTRO. ANN. GRASSES	---	---	(1)	---	---
NATIVE PERENNIAL FORBS					
Aster arenosus			1(1)		P
Astragalus calycosus var. scapiosus				P	
Astragalus wingatanus		P		1	
Calochortus nuttallii					
Cryptantha sp.	P				
Cymopterus purpurascens		P			
Eriogonum alatum			P		
Eriogonum umbellatum					
Haplopappus nuttallii			P		
Lithospermum incisum			P		
Mirabilis multiflora		P	1		P
Oxybaphus linearis					
Pedicularis centrantherum		P			
Penstemon barbatus		P			
Penstemon linarioides	P	P			
Solidago petradoria	P				
Sphaeralcea coccinea			P		
Stanleya pinnata			P		
Streptanthus cordatus					
TOTAL NATIVE PERENNIAL FORBS	P	P	2(1)	1	P
NATIVE PERENNIAL GRASSES (cool)					
Carex occidentalis					
Oryzopsis hymenoides		1	1	P	P
Poa fendleriana					
Sitanion longifolium	P	P	P		1
Stipa comata			P		
TOTAL NATIVE PERENNIAL GRASSES (c)	P	1	1	P	1
NATIVE PERENNIAL GRASSES (warm)					
Bouteloua gracilis		P	1	P	
Hilaria jamesii			2(2)		
TOTAL NATIVE PERENNIAL GRASSES (w)	---	P	3(2)	P	---
NATIVE SUBSHRUBS					
Chrysothamnus greenei					
Eriogonum microthecum		P			
Gutierrezia sarothrae	P	P	1	P	P
TOTAL NATIVE SUBSHRUBS	P	P	1	P	P
NATIVE SHRUBS					
Artemisia tridentata		1	2	P	3
Atriplex canescens		P	P	P	
Chrysothamnus viscidiflorus	P			P	P
Cowania mexicana	3		P	P	
Ephedra viridis	P				P
Haplopappus laricifolius		P			
TOTAL NATIVE SHRUBS	3	1	2	P	3

Table 19. Cover Data - N10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

Percent Foliar Cover*

PLANT SPECIES	----Sample Number----				
	6	7	8	9	10
NATIVE TREES					
Juniperus osteosperma	13	3	4	8	P
Pinus edulis	9	4	P	4	2
Quercus gambelii				3	
TOTAL NATIVE TREES	22	7	4	15	2
MOSS					
Moss		P			
TOTAL MOSS	---	P	---	---	---
LICHEN					
Parmelia chlorochroa				P	P
TOTAL LICHEN	---	---	---	P	P
SUCCULENT					
Echinocereus triglochidiatus var. mojavensis			P		P
Opuntia polyacantha	1	P			
TOTAL SUCCULENT	1	P	P	---	P
AGAVOIDS					
Yucca angustissima					
Yucca baccata			P	P	1
TOTAL AGAVOIDS	---	---	P	P	1
Standing dead	4	3	11		6
Litter	16	20	7	5	23
Bare ground	35	68	20	58	54
Rock	19		48	21	10
TOTALS	100	100	100	100	100
TOTAL VEGETATION COVER	26	9	14(4)	16	7
GROUND COVER (Litter+Rock+Veg+St.Dead	65	32	80(4)	42	46
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 15.7 Std.Dev.= 5.3)	12	19	26	14	14

*P=Present within 1 m. of either side of the cover transect, but not quantitatively encountered.

Table 20. Woody Plant Density Data - J2 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Ceratoides lanata	5.60	226.6	20.00		28			
Chrysothamnus greenei	29.60	1,197.9	80.00	12	6	31		99
Eriogonum microthecum	0.40	16.2	20.00			2		
Gutierrezia sarothrae	33.60	1,359.8	60.00		3	123		42
Leptodactylon pungens	1.60	64.8	40.00			1	7	
TOTAL NATIVE SUBSHRUBS	70.8	2,865.3	100.0	12	37	157	7	141
NATIVE SHRUBS								
Artemisia tridentata	89.20	3,609.9	100.00	85	77	69	56	159
Chrysothamnus viscidiflorus	22.60	914.6	100.00	15	86	2	9	1
Tetradymia canescens	0.40	16.2	20.00	2				
TOTAL NATIVE SHRUBS	112.2	4,540.7	100.0	102	163	71	65	160
NATIVE TREES								
Pinus edulis	0.60	24.3	60.00	1		1	1	
TOTAL NATIVE TREES	0.6	24.3	60.0	1	---	1	1	---
TOTAL DENSITY	183.6	7,430.3		115	200	229	73	301
Standard Deviation	90.9	3,678.7						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 5.0 Std.Dev.= 1.2)				5	5	7	4	4

Table 21. Woody Plant Density Data - J4 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Gutierrezia sarothrae	10.00	404.7	40.00	36				14
Leptodactylon pungens	1.00	40.5	20.00					5
TOTAL NATIVE SUBSHRUBS	11.0	445.2	40.0	36	---	---	---	19
NATIVE SHRUBS								
Artemisia tridentata	8.20	331.9	20.00		41			
Atriplex canescens	54.40	2,201.6	80.00	58		52	71	91
Chrysothamnus viscidiflorus	86.60	3,504.7	100.00	107	108	99	73	46
TOTAL NATIVE SHRUBS	149.2	6,038.1	100.0	165	149	151	144	137
NATIVE TREES								
Juniperus osteosperma	1.60	64.8	20.00					8
Pinus edulis	1.20	48.6	40.00				2	4
TOTAL NATIVE TREES	2.8	113.3	40.0	---	---	---	2	12
TOTAL DENSITY	163.0	6,596.6		201	149	151	146	168
Standard Deviation	22.9	926.8						
SPECIES DENSITY (# of species/100 sq.m.)				3	2	2	3	6
(AVERAGE= 3.2 Std.Dev.= 1.6)								

Table 22. Woody Plant Density Data - J5/6 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Ceratoides lanata	4.00	161.9	40.00	1			19	
Chrysothamnus greenei	94.20	3,812.3	80.00	25	439		4	3
Gutierrezia sarothrae	122.00	4,937.3	60.00	2	6		602	
TOTAL NATIVE SUBSHRUBS	220.2	8,911.5	80.0	28	445	---	625	3
NATIVE SHRUBS								
Artemisia tridentata	8.20	331.9	80.00	29		1	7	4
Atriplex canescens	0.20	8.1	20.00			1		
Atriplex confertifolia	15.20	615.1	80.00	12	19	35	10	
Chrysothamnus viscidiflorus	206.60	8,361.1	100.00	259	44	118	164	448
Sarcobatus vermiculatus	0.20	8.1	20.00	1				
TOTAL NATIVE SHRUBS	230.4	9,324.3	100.0	301	63	155	181	452
TOTAL DENSITY	450.6	18,235.8		329	508	155	806	455
Standard Deviation	240.7	9,741.1						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 4.8 Std.Dev.= 1.6)				7	4	4	6	3

Table 23. Woody Plant Density Data - J8 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Ceratoides lanata	2.80	113.3	60.00	11	1			2
Chrysothamnus greenei	0.60	24.3	40.00			2		1
Eriogonum microthecum	0.80	32.4	20.00					4
Gutierrezia sarothrae	2.40	97.1	20.00			12		
TOTAL NATIVE SUBSHRUBS	6.6	267.1	80.0	11	1	14	---	7
NATIVE SHRUBS								
Artemisia tridentata	17.20	696.1	100.00	2	60	5	1	18
Atriplex canescens	11.00	445.2	60.00	46		5		4
Atriplex confertifolia	5.40	218.5	60.00	5	1		21	
Chrysothamnus viscidiflorus	50.40	2,039.7	100.00	47	35	34	13	123
Lycium pallidum	4.80	194.3	40.00	5				19
Sarcobatus vermiculatus	0.20	8.1	20.00	1				
TOTAL NATIVE SHRUBS	89.0	3,601.8	100.0	106	96	44	35	164
NATIVE TREES								
Juniperus osteosperma	0.60	24.3	60.00		1	1	1	
Pinus edulis	0.20	8.1	20.00					1
TOTAL NATIVE TREES	0.8	32.4	80.0	---	1	1	1	1
SUCCULENT								
Opuntia whipplei	0.20	8.1	20.00			1		
TOTAL SUCCULENT	0.2	8.1	20.0	---	---	1	---	---
TOTAL DENSITY	96.6	3,909.4		117	98	60	36	172
Standard Deviation	52.7	2,132.8						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 6.2 Std.Dev.= 1.6)				7	5	7	4	8

Table 24. Woody Plant Density Data - J10 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Artemisia frigida	0.20	8.1	20.00				1	
Ceratoides lanata	0.40	16.2	40.00	1	1			
Chrysothamnus greenei	25.10	1,015.8	80.00	22	78	22		4
Eriogonum microthecum	0.20	8.1	20.00		1			
Gutierrezia sarothrae	2.20	89.0	40.00		4			7
Leptodactylon pungens	5.00	202.4	60.00		3		1	21
TOTAL NATIVE SUBSHRUBS	32.9	1,331.5	100.0	22	87	22	2	32
NATIVE SHRUBS								
Artemisia tridentata	87.20	3,529.0	100.00	135	125	26	73	77
Atriplex canescens	24.20	979.4	80.00	1	2	13	106	
Chrysothamnus nauseosus	0.40	16.2	20.00	2				
Chrysothamnus viscidiflorus	9.60	388.5	60.00			27	21	1
Sarcobatus vermiculatus	0.60	24.3	20.00				3	
Tetradymia canescens	0.40	16.2	20.00			2		
TOTAL NATIVE SHRUBS	122.3	4,949.5	100.0	137	127	68	203	77
NATIVE TREES								
Juniperus osteosperma	0.40	16.2	40.00	1				1
Pinus edulis	1.00	40.5	80.00	1	1	1		2
TOTAL NATIVE TREES	0.8	32.4	60.0	---	1	1	---	2
TOTAL DENSITY	156.0	6,313.3		158	215	91	205	111
Standard Deviation	55.1	2,229.9						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 6.8 Std.Dev.= 0.8)				7	8	6	6	7

Table 25. Woody Plant Density Data - J13/14 Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Ceratoides lanata	0.40	16.2	20.00			2		
Chrysothamnus greenei	21.20	858.0	20.00			106		
Gutierrezia sarothrae	23.80	963.2	60.00		1	114		4
Haplopappus drummondii	0.40	16.2	20.00		2			
Leptodactylon pungens	0.60	24.3	20.00					3
Senecio douglasii var. longilobus	1.00	40.5	40.00			1	4	
TOTAL NATIVE SUBSHRUBS	47.4	1,918.3	80.0	---	3	223	4	7
NATIVE SHRUBS								
Artemisia tridentata	0.40	16.2	40.00		1	1		
Atriplex canescens	0.40	16.2	20.00				2	
Atriplex confertifolia	20.00	809.4	40.00	57	43			
Chrysothamnus viscidiflorus	253.00	10,238.9	100.00	8	12	31	***	102
Sarcobatus vermiculatus	2.40	97.1	20.00		12			
TOTAL NATIVE SHRUBS	276.2	11,177.8	100.0	65	68	32	***	102
NATIVE TREES								
Juniperus osteosperma	1.00	40.5	40.00			3	2	
TOTAL NATIVE TREES	1.0	40.5	40.0	---	---	3	2	---
TOTAL DENSITY	324.6	13,136.6		65	71	258	1120	109
Standard Deviation	451.5	18,272.2						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 4.4 Std.Dev.= 2.1)				2	6	7	4	3

Table 26. Woody Plant Density Data - J15 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Ceratoides lanata	0.60	24.3	40.00	2	1			
Chrysothamnus greenei	2.20	89.0	60.00	3		1	7	
Gutierrezia sarothrae	5.00	202.4	60.00	5			3	17
TOTAL NATIVE SUBSHRUBS	7.8	315.7	100.0	10	1	1	10	17
NATIVE SHRUBS								
Artemisia tridentata	79.80	3,229.5	100.00	72	103	66	70	88
Atriplex canescens	1.20	48.6	40.00				1	5
Atriplex confertifolia	1.00	40.5	20.00					5
Chrysothamnus nauseosus	0.20	8.1	20.00		1			
Chrysothamnus viscidiflorus	14.80	599.0	100.00	6	8	24	7	29
TOTAL NATIVE SHRUBS	97.0	3,925.6	100.0	78	112	90	78	127
NATIVE TREES								
Juniperus osteosperma	0.80	32.4	60.00	2			1	1
Pinus edulis	3.00	121.4	80.00	11	1		2	1
TOTAL NATIVE TREES	3.8	153.8	80.0	13	1	---	3	2
TOTAL DENSITY	108.6	4,395.0		101	114	91	91	146
Standard Deviation	22.9	926.8						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 5.8 Std.Dev.= 1.8)				7	5	3	7	7

Table 27. Woody Plant Density Data - J28 LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus greenei	105.40	4,265.5	60.00	398	5	124		
Gutierrezia sarothrae	1.00	40.5	60.00		2		1	2
TOTAL NATIVE SUBSHRUBS	106.4	4,306.0	100.0	398	7	124	1	2
NATIVE SHRUBS								
Artemisia tridentata	105.20	4,257.4	100.00	30	195	38	88	175
Atriplex canescens	2.20	89.0	60.00		2	1		8
Chrysothamnus viscidiflorus	24.00	971.3	40.00			50		70
Sarcobatus vermiculatus	9.80	396.6	20.00					49
TOTAL NATIVE SHRUBS	141.2	5,714.4	100.0	30	197	89	88	302
NATIVE TREES								
Pinus edulis	0.80	32.4	40.00		1		3	
TOTAL NATIVE TREES	0.8	32.4	40.0	---	1	---	3	---
TOTAL DENSITY	248.4	10,052.7		428	205	213	92	304
Standard Deviation	125.4	5,074.9						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 3.8 Std.Dev.= 1.3)				2	5	4	3	5

Table 28. Woody Plant Density Data - N12/N99 NORTH/SOUTH LOMCRA Sagebrush Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 100 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 100 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Artemisia frigida	0.20	8.1	20.00		1			
Chrysothamnus greenei	3.00	121.4	20.00				15	
Eurotia lanata	0.20	8.1	20.00			1		
Gutierrezia sarothrae	0.20	8.1	20.00				1	
TOTAL NATIVE SUBSHRUBS	3.6	145.7	60.0	---	1	1	16	---
NATIVE SHRUBS								
Artemisia tridentata	101.40	4,103.7	100.00	53	99	69	105	181
Atriplex canescens	20.80	841.8	60.00	13		53	38	
Chrysothamnus nauseosus	10.60	429.0	20.00		53			
Chrysothamnus viscidiflorus	39.80	1,610.7	60.00	123		71		5
TOTAL NATIVE SHRUBS	172.6	6,985.1	100.0	189	152	193	143	186
INTRODUCED SHRUBS								
Tamarix pentandra	0.20	8.1	20.00		1			
TOTAL INTRODUCED SHRUBS	0.2	8.1	20.0	---	1	---	---	---
NATIVE TREES								
Pinus edulis	1.40	56.7	60.00	1	1			5
TOTAL NATIVE TREES	1.4	56.7	60.0	1	1	---	---	5
TOTAL DENSITY	177.8	7,195.6		190	155	194	159	191
Standard Deviation	19.1	773.0						
SPECIES DENSITY (# of species/100 sq.m.) (AVERAGE= 4.0 Std.Dev.= 0.7)				4	5	4	4	3

Table 29. Woody Plant Density Data - J2 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus depressus	0.20	4.05	20.00		1			
Chrysothamnus greenei	15.20	307.57	80.00	16		13	39	8
Eriogonum aureum	0.40	8.09	40.00			1	1	
Gutierrezia sarothrae	8.20	165.93	80.00		9	9	6	17
Leptodactylon pungens	0.40	8.09	20.00		2			
TOTAL NATIVE SUBSHRUBS	24.4	493.7	100.0	16	12	23	46	25
NATIVE SHRUBS								
Artemisia tridentata	37.80	764.88	100.00	30	37	42	11	69
Atriplex canescens	0.40	8.09	20.00				2	
Chrysothamnus nauseosus	3.80	76.89	20.00		19			
Chrysothamnus viscidiflorus	12.80	259.01	80.00	2	4	36	22	
Ephedra viridis	1.00	20.24	20.00		5			
TOTAL NATIVE SHRUBS	55.8	1,129.1	100.0	32	65	78	35	69
NATIVE TREES								
Juniperus osteosperma	3.40	68.80	100.00	7	2	3	4	1
Pinus edulis	4.00	80.94	60.00		9		4	7
TOTAL NATIVE TREES	7.4	149.7	100.0	7	11	3	8	8
TOTAL DENSITY	87.6	1,772.6		55	88	104	89	102
Standard Deviation	19.6	396.6						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 6.4 Std.Dev.= 2.1)				4	9	6	8	5

Table 30. Woody Plant Density Data - J4 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus depressus	9.40	190.21	40.00	3			44	
Eurotia lanata	0.40	8.09	20.00				2	
Gutierrezia sarothrae	0.80	16.19	40.00	2			2	
TOTAL NATIVE SUBSHRUBS	10.6	214.5	40.0	5	---	---	48	---
NATIVE SHRUBS								
Artemisia tridentata	8.40	169.97	60.00	6	21		15	
Atriplex canescens	11.20	226.63	40.00			46		10
Chrysothamnus viscidiflorus	79.20	1,602.61	100.00	37	21	24	307	7
TOTAL NATIVE SHRUBS	98.8	1,999.2	100.0	43	42	70	322	17
NATIVE TREES								
Juniperus osteosperma	6.40	129.50	100.00	5	9	10	7	1
Pinus edulis	2.20	44.52	100.00	1	2	5	2	1
TOTAL NATIVE TREES	8.6	174.0	100.0	6	11	15	9	2
AGAVOIDS								
Yucca angustissima	0.40	8.09	20.00					2
TOTAL AGAVOIDS	0.4	8.1	20.0	---	---	---	---	2
TOTAL DENSITY	118.4	2,395.8		54	53	85	379	21
Standard Deviation	147.4	2,982.6						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 5.2 Std.Dev.= 1.3)				6	4	4	7	5

Table 31. Woody Plant Density Data - J8 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus depressus	0.20	4.05	20.00	1				
Gutierrezia sarothrae	0.40	8.09	20.00					2
TOTAL NATIVE SUBSHRUBS	0.6	12.1	40.0	1	---	---	---	2
NATIVE SHRUBS								
Artemisia tridentata	34.20	692.04	100.00	15	7	6	88	55
Atriplex canescens	6.60	133.55	80.00	8		17	4	4
Chrysothamnus viscidiflorus	82.40	1,667.36	100.00	48	226	84	36	18
Lycium pallidum	5.80	117.36	40.00	8	21			
TOTAL NATIVE SHRUBS	129.0	2,610.3	100.0	79	254	107	128	77
NATIVE TREES								
Juniperus osteosperma	4.80	97.13	100.00	5	3	7	7	2
Pinus edulis	0.20	4.05	20.00					1
TOTAL NATIVE TREES	5.0	101.2	100.0	5	3	7	7	3
SUCCULENT								
Opuntia macrorhiza	0.40	8.09	20.00		2			
TOTAL SUCCULENT	0.4	8.1	20.0	---	2	---	---	---
TOTAL DENSITY	135.0	2,731.7		85	259	114	135	82
Standard Deviation	72.7	1,471.1						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 5.0 Std.Dev.= 1.0)				6	5	4	4	6

Table 32. Woody Plant Density Data - J10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus greenei	19.60	396.61	100.00	7	18	15	8	50
Eriogonum aureum	0.20	4.05	20.00		1			
Gutierrezia sarothrae	4.40	89.03	40.00	3	19			
TOTAL NATIVE SUBSHRUBS	24.2	489.7	100.0	10	38	15	8	50
NATIVE SHRUBS								
Artemisia tridentata	29.40	594.91	100.00	30	16	74	5	22
Atriplex canescens	5.00	101.18	80.00	1	2		12	10
Chrysothamnus nauseosus	0.20	4.05	20.00				1	
Chrysothamnus viscidiflorus	0.60	12.14	20.00					3
Ephedra viridis	0.20	4.05	20.00					1
Lycium pallidum	0.20	4.05	20.00		1			
Shepherdia rotundifolia	11.80	238.77	40.00				52	7
TOTAL NATIVE SHRUBS	47.4	959.1	100.0	31	27	74	70	43
NATIVE TREES								
Juniperus osteosperma	2.20	44.52	100.00	4	2	2	2	1
Pinus edulis	2.80	56.66	100.00	3	2	3	3	3
TOTAL NATIVE TREES	5.0	101.2	100.0	7	4	5	5	4
AGAVOIDS								
Yucca angustissima	1.60	32.38	20.00		8			
TOTAL AGAVOIDS	1.6	32.4	20.0	---	8	---	---	---
TOTAL DENSITY	78.2	1,582.4		48	69	94	83	97
Standard Deviation	20.1	406.7						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 6.8 Std.Dev.= 1.9)				6	9	4	7	8

Table 33. Woody Plant Density Data - J13/14 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Gutierrezia sarothrae	21.20	428.98	60.00		6		95	5
Haplopappus drummondii	1.00	20.24	20.00		5			
Leptodactylon pungens	1.00	20.24	20.00					5
TOTAL NATIVE SUBSHRUBS	23.2	469.5	60.0	---	11	---	95	10
NATIVE SHRUBS								
Artemisia tridentata	5.80	117.36	60.00	3	1			25
Atriplex canescens	0.20	4.05	20.00					1
Atriplex confertifolia	6.20	125.46	60.00		19		5	7
Chrysothamnus viscidiflorus	154.20	3,120.24	100.00	192	169	224	67	119
Lycium pallidum	6.40	129.50	20.00				32	
TOTAL NATIVE SHRUBS	172.8	3,496.6	100.0	195	189	224	104	152
NATIVE TREES								
Juniperus osteosperma	3.00	60.71	100.00	3	2	5	2	3
Pinus edulis	0.40	8.09	40.00				1	1
TOTAL NATIVE TREES	3.4	68.8	100.0	3	2	5	3	4
AGAVOIDS								
Yucca angustissima	2.00	40.47	60.00	1		7		2
TOTAL AGAVOIDS	2.0	40.5	60.0	1	---	7	---	2
TOTAL DENSITY	201.4	4,075.3		199	202	236	202	168
Standard Deviation	24.1	487.7						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 5.6 Std.Dev.= 2.3)				4	6	3	6	9

Table 34. Woody Plant Density Data - J15 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus greenei	4.40	89.03	20.00	22				
Eriogonum aureum	0.80	16.19	20.00					4
Gutierrezia sarothrae	11.60	234.73	60.00	16	38			4
Haplopappus drummondii	1.40	28.33	40.00	3	4			
TOTAL NATIVE SUBSHRUBS	18.2	368.3	60.0	41	42	---	---	8
NATIVE SHRUBS								
Artemisia tridentata	19.60	396.61	100.00	7	71	1	10	9
Chrysothamnus viscidiflorus	16.00	323.76	80.00	25	16	1	38	
Cowania mexicana	0.80	16.19	20.00			4		
Ephedra viridis	0.80	16.19	20.00	4				
TOTAL NATIVE SHRUBS	37.2	752.7	100.0	36	87	6	48	9
NATIVE TREES								
Juniperus osteosperma	3.60	72.85	100.00	2	5	5	2	4
Pinus edulis	3.60	72.85	100.00	5	1	2	2	8
TOTAL NATIVE TREES	7.2	145.7	100.0	7	6	7	4	12
AGAVOIDS								
Yucca angustissima	1.20	24.28	20.00			6		
TOTAL AGAVOIDS	1.2	24.3	20.0	---	---	6	---	---
TOTAL DENSITY	63.8	1,291.0		84	135	19	52	29
Standard Deviation	47.0	951.0						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 5.8 Std.Dev.= 1.5)				8	6	6	4	5

Table 35. Woody Plant Density Data - J28 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5
NATIVE SUBSHRUBS								
Chrysothamnus depressus	0.20	4.05	20.00		1			
Chrysothamnus greenei	9.60	194.26	40.00		47		1	
Eriogonum aureum	2.40	48.56	40.00			3		9
Gutierrezia sarothrae	57.00	1,153.40	80.00	113		28	51	93
Senecio douglasii var. longilobus	0.20	4.05	20.00	1				
TOTAL NATIVE SUBSHRUBS	69.4	1,404.3	100.0	114	48	31	52	102
NATIVE SHRUBS								
Artemisia tridentata	58.80	1,189.82	100.00	2	31	50	14	197
Atriplex canescens	1.60	32.38	20.00		8			
Chrysothamnus nauseosus	0.20	4.05	20.00	1				
Chrysothamnus viscidiflorus	15.60	315.67	20.00		78			
Cowania mexicana	2.20	44.52	20.00	11				
Haplopappus laricifolius	4.20	84.99	60.00	16	2	3		
Lycium pallidum	18.20	368.28	20.00				91	
TOTAL NATIVE SHRUBS	100.8	2,039.7	100.0	30	119	53	105	197
NATIVE TREES								
Juniperus osteosperma	2.80	56.66	100.00	2	3	5	1	3
Pinus edulis	5.00	101.18	100.00	3	2	12	6	2
TOTAL NATIVE TREES	7.8	157.8	100.0	5	5	17	7	5
AGAVOIDS								
Yucca angustissima	0.20	4.05	20.00	1				
TOTAL AGAVOIDS	0.2	4.05	20.0	1	---	---	---	---
TOTAL DENSITY	178.2	3,605.9		150	172	101	164	304
Standard Deviation	76	1,527.7						
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 6.8 Std.Dev.= 1.6)				9	8	6	6	5

Table 36. Woody Plant Density Data - N12/N99 NORTH/SOUTH LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5	6	7	8	9	10
NATIVE SUBSHRUBS													
Chrysothamnus depressus	0.40	8.09	10.00					4					
Eriogonum aureum	0.10	2.02	10.00							1			
Eriogonum corymbosum	0.60	12.14	30.00		1			2					3
Gutierrezia sarothrae	9.60	194.26	30.00						2		77		17
TOTAL NATIVE SUBSHRUBS	10.7	216.5	60.0	---	1	---	---	6	2	1	77	---	20
NATIVE SHRUBS													
Artemisia tridentata	0.80	16.19	40.00	5	1		1			1			
Atriplex canescens	0.90	18.21	10.00	9									
Chrysothamnus viscidiflorus	2.20	44.52	40.00	2	1			2		17			
Cowania mexicana	8.50	172.00	70.00	1	13	15		9	28		15	4	
Ephedra viridis	0.10	2.02	10.00									1	
TOTAL NATIVE SHRUBS	12.5	252.9	90.0	17	15	15	1	11	28	18	15	5	---
NATIVE TREES													
Juniperus osteosperma	4.00	80.94	100.00	4	1	3	5	2	7	4	1	9	4
Pinus edulis	5.20	105.22	90.00		6	7	6	3	8	10	6	3	3
TOTAL NATIVE TREES	9.2	186.2	100.0	4	7	10	11	5	15	14	7	12	7
AGAVOIDS													
Yucca angustissima	0.10	2.02	10.00		1								
TOTAL AGAVOIDS	0.1	2.0	10.0	---	1	---	---	---	---	---	---	---	---
TOTAL DENSITY	32.5	657.6		21	24	25	12	22	45	33	99	17	27
Standard Deviation	25.0	505.9											
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 4.5 Std.Dev.= 1.3)				5	7	3	3	6	4	5	4	4	4

Table 37. Woody Plant Density Data - N9 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5	6	7	8	9	10
NATIVE SUBSHRUBS													
Chrysothamnus depressus	0.90	18.21	10.00									9	
Gutierrezia sarothrae	16.30	329.83	100.00	7	1	16	23	1	92	5	1	16	1
TOTAL NATIVE SUBSHRUBS	17.2	348.0	100.0	7	1	16	23	1	92	5	1	25	1
NATIVE SHRUBS													
Artemisia tridentata	11.90	240.80	70.00	19	5	34			37	1	5	18	
Atriplex canescens	0.30	6.07	10.00		3								
Chrysothamnus viscidiflorus	11.20	226.63	20.00		77			35					
Cowania mexicana	3.00	60.71	40.00		1		6	3					20
Ephedra viridis	0.50	10.12	20.00			4				1			
Purshia tridentata	0.20	4.05	20.00				1						1
Shepherdia rotundifolia	0.10	2.02	10.00							1			
TOTAL NATIVE SHRUBS	27.2	550.4	100.0	19	86	38	7	38	37	3	5	18	21
NATIVE TREES													
Juniperus osteosperma	3.80	76.89	100.00	4	5	4	1	2	4	6	3	7	2
Pinus edulis	9.60	194.26	100.00	7	2	8	11	5	7	17	14	17	8
Quercus gambelii	0.20	4.05	10.00							2			
TOTAL NATIVE TREES	13.6	275.2	100.0	11	7	12	12	7	11	25	17	24	10
TOTAL DENSITY	58.0	1,173.6		37	94	66	42	46	140	33	23	67	32
Standard Deviation	36	724.4											
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 5.1 Std.Dev.= 1.1)				4	7	5	5	5	4	7	4	5	5

Table 38. Woody Plant Density Data - N10 LOMCRA Pinyon-Juniper Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

PLANT SPECIES	AVERAGE DENSITY (per 200 sq.m.)	DENSITY (per acre)	FREQUENCY (%)	Shrubs per 200 sq.m. -----Sample Number----- 1	2	3	4	5	6	7	8	9	10
NATIVE SUBSHRUBS													
Chrysothamnus greenei	6.30	127.48	20.00				61			2			
Gutierrezia sarothrae	40.60	821.54	80.00	1	122		44	13		6	193	8	19
TOTAL NATIVE SUBSHRUBS	46.9	949.0	80.0	1	122	---	105	13	---	8	193	8	19
NATIVE SHRUBS													
Artemisia tridentata	8.60	174.02	70.00	1	30			5		25	6	3	16
Atriplex canescens	1.10	22.26	30.00				5				1	5	
Chrysothamnus viscidiflorus	3.70	74.87	60.00	4			16		13	1	2	1	
Cowania mexicana	5.20	105.22	60.00	7		21		1	21			1	1
Ephedra viridis	1.00	20.24	40.00			3			3		2		2
TOTAL NATIVE SHRUBS	19.6	396.6	100.0	12	30	24	21	6	37	26	11	10	19
NATIVE TREES													
Juniperus osteosperma	5.40	109.27	90.00	3	6	3	16	7	4		2	3	10
Pinus edulis	9.00	182.12	100.00	18	14	8	3	22	7	10	4	2	2
Quercus gambelii	2.40	48.56	10.00									24	
TOTAL NATIVE TREES	16.8	339.9	100.0	21	20	11	19	29	11	10	6	29	12
AGAVOIDS													
Yucca angustissima	1.10	22.26	10.00					11					
Yucca baccata	0.60	12.14	30.00								1	1	4
TOTAL AGAVOIDS	1.70	34.40	40.0	---	---	---	---	11	---	---	1	1	4
TOTAL DENSITY	85.0	1,720.0		34	172	35	145	59	48	44	211	48	54
Standard Deviation	65.2	1,319.3											
SPECIES DENSITY (# of species/200 sq.m.) (AVERAGE= 6.0 Std.Dev.= 1.6)				6	4	4	6	6	5	5	8	9	7

Table 39. Cover and Woody Plant Density Data Summary, LOMCRA Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

AREA	TOTAL FOLIAR COVER (%)	STANDING DEAD (%)	LITTER (%)	ROCK (%)	SOIL (%)	WOODY PLANT DENSITY (shrubs/acre)
J2 SAGEBRUSH	14.4	8.4	16.0	3.2	58.0	7,430.3
J2 PINYON-JUNIPER	19.6	4	16.4	8.6	51.4	1773
J4 SAGEBRUSH	9.2	10.6	3.8	1.8	74.6	6,596.6
J4 PINYON-JUNIPER	14.2	2.4	13.2	16.6	53.6	2,395.8
J5/6 SAGEBRUSH	8.2	8.0	10.4	11.2	62.2	18,235.8
J8 SAGEBRUSH	7.0	11.8	8.4	11.8	61.0	3,909.4
J8 PINYON-JUNIPER	13.6	5.4	11.8	19.4	49.8	2,731.7
J10 SAGEBRUSH	10.6	10.4	12.6	3.0	63.4	6,313.3
J10 PINYON-JUNIPER	19.4	1.4	16.4	17.2	45.6	1,582.4
J13/14 SAGEBRUSH	8.6	9.0	7.6	15.4	59.4	13,136.6
J13/14 PINYON-JUNIPER	11.6	6.4	15.8	19.0	47.2	4,075.3
J15 SAGEBRUSH	12.4	6.2	17.4	1.6	62.4	4,395.0
J15 PINYON-JUNIPER	17.6	0.8	15.6	23.8	42.2	1,291.0
J28 SAGEBRUSH	17.2	8.2	6.6	1.4	66.6	10,052.7
J28 PINYON-JUNIPER	20.4	2.8	24.2	6.8	45.8	3,605.9
N12/N99 SAGEBRUSH NORTH/SOUTH	13.8	15.2	21	3.2	46.8	7,195.6
N12/N99 PINYON-JUNIPER NORTH/SOUTH	16.4	2.9	20	20.1	40.6	657.6
N9 PINYON-JUNIPER	22.0	4.3	12.6	13.7	47.4	1,173.6
N10 PINYON-JUNIPER	14.0	3.6	13.1	24.7	44.6	1,720.0

Table 40. Relative Vegetation Cover by Lifeform Data Summary, LOMCRA Baseline, Black Mesa Mining Complex, PWCC, AZ - 2003

RELATIVE VEGETATION COVER - ALL HITS (%)

			---------INTRODUCED---------						---------NATIVE---------								
		TOTAL	---FORBS---		---GRASSES---			TOTAL	---FORBS---		---GRASSES---			SUB-SHRUBS			
AREA	**TOTAL***	INTRO. SP.	ANNUAL+	PERENN.	ANNUAL	PERENN. (C)	SUB-SHRUBS	NATIVE SP.	ANNUAL+	PERENN.	ANNUAL+	PERENN. (C)	PERENN. (W)		SHRUBS	TREES	OTHER**
J2 SAGEBRUSH	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	2.8	0.0	1.4	5.6	13.9	6.9	63.9	0.0	5.6
J2 PINYON-JUNIPER	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	0.0	0.0	0.0	2.0	2.0	0.0	12.1	83.8	0.0
J4 SAGEBRUSH	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	6.5	2.2	13.0	4.3	23.9	0.0	50.0	0.0	0.0
J4 PINYON-JUNIPER	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	0.0	0.0	0.0	2.6	11.8	1.3	5.3	75.0	3.9
J5/6 SAGEBRUSH	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	4.9	2.4	0.0	0.0	31.7	12.2	46.3	0.0	2.4
J8 SAGEBRUSH	**100.2**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.2**	0.0	2.9	8.6	0.0	28.6	2.9	48.6	5.7	2.9
J8 PINYON-JUNIPER	**100.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.0**	0.0	0.0	0.0	0.0	4.3	2.9	15.7	77.1	0.0
J10 SAGEBRUSH	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	0.0	0.0	3.7	3.7	29.6	1.9	51.9	9.3	0.0
J10 PINYON-JUNIPER	**100.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.0**	0.0	2.1	0.0	0.0	1.0	3.1	7.2	86.6	0.0
J13/14 SAGEBRUSH	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	4.7	2.3	0.0	4.7	44.2	0.0	39.5	4.7	0.0
J13/14 PINYON-JUNIPER	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	0.0	0.0	0.0	1.7	8.5	1.7	15.3	71.2	1.7
J15 SAGEBRUSH	**99.9**	**1.6**	0.0	0.0	0.0	1.6	0.0	**98.3**	4.8	1.6	0.0	4.8	3.2	0.0	69.4	12.9	1.6
J15 PINYON-JUNIPER	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	0.0	2.2	0.0	1.1	2.2	0.0	7.9	80.9	5.6
J28 SAGEBRUSH	**100.0**	**1.1**	1.1	0.0	0.0	0.0	0.0	**98.9**	4.5	0.0	7.9	3.4	5.6	12.4	64.0	1.1	0.0
J28 PINYON-JUNIPER	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	0.0	0.0	0.0	0.0	1.0	0.0	16.2	82.9	0.0
N12/N99 SAGEBRUSH NORTH/SOUTH	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	4.2	0.0	0.0	2.8	2.8	0.0	87.3	2.8	0.0
N12/N99 PINYON-JUNIPER NORTH/SOUTH	**100.1**	**0.0**	0.0	0.0	0.0	0.0	0.0	**100.1**	0.0	0.6	0.0	0.0	1.2	0.6	10.6	84.1	3.0
N9 PINYON-JUNIPER	**99.9**	**0.0**	0.0	0.0	0.0	0.0	0.0	**99.9**	0.0	1.3	0.0	0.4	0.0	0.0	12.9	84.0	1.3
N10 PINYON-JUNIPER	**100.0**	**0.7**	0.0	0.0	0.7	0.0	0.0	**99.3**	0.7	3.4	0.0	2.1	4.1	0.7	14.5	71.7	2.1

*May sum to 100.0 plus or minus 0.2 due to rounding errors.

** Lower plants (mosses, lichens, parasites), succulents, and agavoids.

+ANNUAL category includes biennials.

Table 41. Species Density Data Summary, LOMCRA Baseline, Black Mesa Mining Complex, PWCC, AZ - 2002

SPECIES DENSITY (number of species / 100 sq.m.)

			-------INTRODUCED-------						-------NATIVE-------								
		TOTAL	---FORBS---		---GRASSES---			TOTAL	---FORBS---		---GRASSES---			SUB			
AREA	TOTAL*	INTRO. SP.	ANNUAL+	PERENN.	ANNUAL	PERENN. (C)	SHRUBS	NATIVE SP.	ANNUAL+	PERENN.	ANNUAL+	PERENN. (C)	PERENN. (W)	SHRUBS	SHRUBS	TREES	OTHER**
J2 SAGEBRUSH	**19.2**	**0.6**	0.6	0.0	0.0	0.0	0.0	**18.6**	5.0	3.6	1.0	1.8	2.0	2.2	2.0	0.2	0.8
J2 PINYON-JUNIPER	**16.4**	**0.0**	0.0	0.0	0.0	0.0	0.0	**16.4**	1.8	3.4	0.2	2.4	2.0	2.2	2.4	1.6	0.4
J4 SAGEBRUSH	**12.2**	**0.4**	0.0	0.2	0.2	0.0	0.0	**11.8**	2.8	1.4	0.4	1.2	1.8	0.8	2.0	0.6	0.8
J4 PINYON-JUNIPER	**14.8**	**0.0**	0.0	0.0	0.0	0.0	0.0	**14.8**	0.4	2.4	0.2	1.8	2.2	2.0	2.2	1.8	1.8
J5/6 SAGEBRUSH	**15.0**	**0.2**	0.2	0.0	0.0	0.0	0.0	**14.8**	1.0	3.2	0.0	1.0	3.2	2.0	2.8	0.0	1.6
J8 SAGEBRUSH	**13.6**	**0.0**	0.0	0.0	0.0	0.0	0.0	**13.6**	0.4	4.0	0.2	1.0	1.8	1.6	3.6	0.6	0.4
J8 PINYON-JUNIPER	**15.8**	**0.0**	0.0	0.0	0.0	0.0	0.0	**15.8**	0.4	4.4	0.0	2.0	1.6	1.8	3.0	1.6	1.0
J10 SAGEBRUSH	**17.6**	**0.0**	0.0	0.0	0.0	0.0	0.0	**17.6**	2.8	2.8	0.6	3.4	1.6	2.6	2.6	0.8	0.4
J10 PINYON-JUNIPER	**13.4**	**0.2**	0.2	0.0	0.0	0.0	0.0	**13.2**	0.2	2.4	0.0	1.2	1.8	2.2	2.4	1.8	1.2
J13/14 SAGEBRUSH	**13.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	**13.0**	1.2	3.8	0.0	1.2	2.6	1.4	1.8	0.2	0.8
J13/14 PINYON-JUNIPER	**15.2**	**0.0**	0.0	0.0	0.0	0.0	0.0	**15.2**	0.4	2.4	0.0	1.8	2.4	2.2	2.6	1.6	1.8
J15 SAGEBRUSH	**17.0**	**0.6**	0.4	0.0	0.0	0.2	0.0	**16.4**	2.8	2.8	0.2	3.2	2.0	1.2	2.6	1.4	0.2
J15 PINYON-JUNIPER	**15.6**	**0.0**	0.0	0.0	0.0	0.0	0.0	**15.6**	0.6	2.8	0.0	2.2	2.4	1.4	1.6	2.0	2.6
J28 SAGEBRUSH	**18.2**	**2.0**	1.4	0.0	0.6	0.0	0.0	**16.2**	4.6	1.8	0.8	2.2	1.4	1.2	2.2	0.4	1.6
J28 PINYON-JUNIPER	**19.8**	**0.4**	0.2	0.0	0.2	0.0	0.0	**19.4**	2.6	5.2	0.2	2.8	1.6	1.6	2.6	1.6	1.2
N12/N99 SAGEBRUSH NORTH/SOUTH	**12.4**	**0.8**	0.2	0.2	0.0	0.2	0.2	**11.6**	1.8	2.4	0.0	1.8	1.0	1.0	2.4	0.6	0.6
N12/N99 PINYON-JUNIPER NORTH/SOUTH	**12.2**	**0.1**	0.0	0.0	0.1	0.0	0.0	**12.1**	0.4	3.0	0.0	1.4	1.0	1.1	1.6	2.0	1.6
N9 PINYON-JUNIPER	**18.9**	**0.4**	0.2	0.0	0.2	0.0	0.0	**18.5**	2.4	5.8	0.0	2.3	1.1	1.0	2.4	2.1	1.4
N10 PINYON-JUNIPER	**15.7**	**0.1**	0.0	0.0	0.1	0.0	0.0	**15.6**	1.3	3.9	0.0	1.8	0.8	1.1	2.6	2.1	2.0

* Due to rounding errors, table values may not exactly match this value.

** Lower plants (mosses, lichens, parasites), succulents, and agavoids.

+ANNUAL category includes biennials.

APPENDIX 2

PLANT SPECIES FROM THE LOMCRA BASELINE STUDY, ALL AREAS

SPECIES	COMMON NAME	SYNONYM	J2 PJUN	J2 SAGE	J4 PJUN	J4 SAGE	J5/6 SAGE	J10 PJUN
NATIVE ANNUAL & BIENNIAL FORBS								
Arenaria hookeri	Hooker sandwort			X				
Aster canescens	hoary tansyaster	Machaeranthera canescens						
Chaenactis stevioides	pincushion			X		X		
Chenopodium berlandieri	pitseed goosefoot							
Chenopodium fremontii	Fremont goosefoot							
Chenopodium hians	maple-leaved goosefoot	C. hybridum						
Chenopodium glaucum	oak-leaved goosefoot							
Chenopodium leptophyllum	narrowleaf goosefoot			X				
Cryptantha crassisepala	cryptantha		X	X		X		
Cryptantha minima	small hiddenflower			X				
Descurainia pinnata	pinnate tansy-mustard		X	X		X		
Descurainia richardsonii	Richardson tansy-mustard							
Draba cuneifolia	whitlowgrass							
Draba reptans	whitlowwort							
Erysimum asperum	wallflower							
Gilia aggregata	skyrocket gilia							
Gilia pumila	gilia	Ipomopsis pumila		X		X		
Gilia sinuata	floccose gilia	G. inconspicua		X	X	X		
Gilia sp.	gilia							
Lappula redowskii	bluebur stickseed		X	X		X	X	
Lappula texana	stickseed	L. marginata	X	X				
Linanthus aureus	yellow gilia	Gilia aurea						
Linum puberulum	yellow flax		X	X	X	X	X	
Lupinus brevicaulus	shortstem lupine							X
Mentzelia albicaulis	blazingstar		X					
Oenothera albicaulis	prairie evening primrose							
Phacelia crenulata	phacelia		X	X				
Plantago purshii	woolly plantain		X			X	X	
Townsendia incana	townsendia			X				
INTRODUCED ANNUAL & BIENNIAL FORBS								
Chenopodium album	common lambsquarter			X				
Chenopodium sp.	goosefoot							
Euphorbia sp.	spurge							X
Kochia scoparia	fireweed summercypress						X	
Salsola kali	Russian thistle			X				
Sisymbrium altissimum	tumble mustard							
Solanum sarachoides	South American nightshade							
Tragopogon dubius	goat's beard							

SPECIES	COMMON NAME	SYNONYM	J2 PJUN	J2 SAGE	J4 PJUN	J4 SAGE	J5/6 SAGE	J10 PJUN
NATIVE ANNUAL GRASSES								
Festuca octoflora	six-weeks fescue		X	X	X	X		
Munroa squarrosa	false buffalograss							
INTRODUCED ANNUAL GRASSES								
Bromus tectorum	cheatgrass					X		
NATIVE PERENNIAL FORBS								
Allium macropetalum	largeflowered onion						X	
Arabis lignifera	woody rockcress							
Asclepias asperula	creeping milkweed							
Asclepias involucrata	Eastwood milkweed	A. macrosperma eastw.	X					
Aster arenosus	white aster	Leucelene ericoides	X	X	X	X	X	X
Astragalus calycosus var. scapiosus	Torrey milkvetch							
Astragalus praelongus	stinking milkvetch		X					
Astragalus wingatanus	Fort Wingate milkvetch		X					
Bahia oppositifolia	Plains bahia	Picradeniopsis oppositifolia						
Calochortus nuttallii	sego lily		X	X		X	X	
Clematis ligusticifolia	Western virginsbower							
Cryptantha flavoculata	cryptantha							
Cryptantha sp.	cryptantha						X	
Cymopterus purpurascens	spring parsley		X	X	X			X
Cymopterus purpureus	purple wafer-parsnip			X				
Delphinium scaposum	barestem larkspur			X			X	
Eriogonum alatum	winged eriogonum							
Eriogonum leptophyllum	buckwheat							
Eriogonum sp.	wild buckwheat				X			
Eriogonum umbellatum	sulfur wild buckwheat							X
Euphorbia fendleri	Fendler spurge		X	X				
Haplopappus armerioides	thrifty goldenweed							
Haplopappus nuttallii	Nuttall goldenweed		X		X			
Haplopappus sp.	goldenweed							X
Hymenopappus pauciflorus	fineleaf bitterweed		X					
Lesquerella intermedia	bladderpod							
Lithospermum incisum	puccoon							
Lygodesmia juncea	skeletonweed					X		
Mirabilis multiflora	colorado four o'clock							X
Mirabilis oxybaphoides	short-calyx four o'clock							

SPECIES	COMMON NAME	SYNONYM	J2 PJUN	J2 SAGE	J4 PJUN	J4 SAGE	J5/6 SAGE	J10 PJUN
NATIVE PERENNIAL FORBS (cont)								
Oenothera coronopifolia	evening-primrose			X	X	X	X	
Oxybaphus linearis	narrowleaf umbrellawort		X				X	
Pedicularis centrantherum	wood betony							
Penstemon barbatus	beardlip penstemon							
Penstemon eatoni	Eaton penstemon							
Penstemon linarioides	mat penstemon							
Penstemon sp.	penstemon							
Phlox longifolia	longleaf phlox		X	X				
Phlox sp.	phlox							
Psilostrophe sparsiflora	greenstem paperflower							
Solidago petradoria	rock goldenrod	Petradoria pumila						X
Sphaeralcea coccinea	scarlet globemallow			X	X	X	X	
Sphaeralcea parvifolia	littleleaf globemallow							
Stanleya pinnata	desert plume							X
Stephanomeria runcinata	desert wirelettuce							
Streptanthus cordatus	twistflower							
Townsendia exscapa	ground daisy						X	
Townsendia sp.	townsendia							
INTRODUCED PERENNIAL FORBS								
Corydalis aurea	scrambled eggs							
Rumex crispus	curly-leaf dock					X		
NATIVE PERENNIAL GRASSES (cool)								
Agropyron dasystachyum	thickspike wheatgrass							
Agropyron smithii	Western wheatgrass		X	X		X		
Carex occidentalis	Western sedge							
Oryzopsis hymenoides	Indian ricegrass		X	X	X	X	X	X
Poa fendleriana	mutton grass		X					
Sitanion jubatum	big squirreltail		X	X				
Sitanion longifolium	bottlebrush squirreltail	Sitanion hystrix		X	X	X		
Stipa comata	needle-and-thread grass		X	X	X	X	X	X
INTRODUCED PERENNIAL GRASSES (cool)								
Elymus junceus	Russian wildrye							
Poa compressa	Canada bluegrass							
Puccinellia distans	European alkaligrass							

SPECIES	COMMON NAME	SYNONYM	J2 PJUN	J2 SAGE	J4 PJUN	J4 SAGE	J5/6 SAGE	J10 PJUN
NATIVE PERENNIAL GRASSES (warm)								
Aristida purpurea	purple three-awn		X		X		X	
Bouteloua gracilis	blue grama		X	X	X	X	X	X
Hilaria jamesii	galleta		X	X	X	X	X	X
Sporobolus airoides	alkali sacaton						X	
Sporobolus cryptandrus	sand dropseed					X		
NATIVE SUBSHRUBS								
Artemisia frigida	fringed sagewort							
Chrysothamnus depressus	dwarf rabbitbrush		X		X			
Chrysothamnus greenei	Greene rabbitbrush		X	X	X		X	X
Eriogonum aureum	slenderbush wild buckwheat	E. microthecum	X	X	X	X		X
Eriogonum corymbosum	buckwheat							X
Eurotia lanata	winterfat	Ceratoides lanata		X	X		X	
Gutierrezia sarothrae	broom snakeweed		X	X	X	X	X	X
Haplopappus drummondii	Drummond goldenweed						X	
Leptodactylon pungens	granite pricklygilia		X	X		X		
Polygala subspinosa	cushion milkwort							
Senecio douglasii var. longilobus	threadleaf groundsel							
NATIVE SHRUBS								
Artemisia tridentata	big sagebrush		X	X	X	X	X	X
Atriplex canescens	four-wing saltbush		X		X	X	X	X
Atriplex confertifolia	shadscale saltbush						X	
Chrysothamnus nauseosus	rubber rabbitbrush		X					
Chrysothamnus viscidiflorus	sticky-leaved rabbitbrush		X	X	X	X	X	
Cowania mexicana	cliff rose	Purshia stansburiana						X
Ephedra viridis	mountain joint-fir		X					X
Forestiera neomexicana	desert olive							
Haplopappus laricifolius	turpentine-bush	Ericameria laricifolius						
Lycium pallidum	rabbitthorn							X
Purshia tridentata	antelope bitterbrush							
Sarcobatus vermiculatus	black greasewood						X	
Shepherdia rotundifolia	roundleaf buffaloberry							X
Tetradymia canescens	gray feltthorn							
INTRODUCED SHRUBS								
Tamarix pentandra	saltcedar							

SPECIES	COMMON NAME	SYNONYM	J2 PJUN	J2 SAGE	J4 PJUN	J4 SAGE	J5/6 SAGE	J10 PJUN
NATIVE TREES								
Juniperus osteosperma	Utah juniper		X		X	X		X
Pinus edulis	Colorado pinyon		X	X	X	X		X
Quercus gambelii	Gambel oak							
MOSSES								
Moss	moss			X	X	X		X
Polytrichum piliferum	moss							
LICHENS								
Collema tenax	lichen							
Lecidea decipiens	lichen							
Lecidea sp.	lichen							
Lichen	lichen							
Parmelia chlorochroa	lichen	Xanthoparmelia chlorochroa				X		X
SUCCULENTS								
Echinocereus triglochidiatus var. mojavensis	Mojave claret-cup							
Mammilaria microcarpa	pincushion cactus							
Mammillaria sp.	pincushion cactus		X		X			
Opuntia fragilis var. fragilis	little pricklypear			X				
Opuntia macrorhiza	thickroot pricklypear				X	X	X	X
Opuntia phaeacantha	pricklypear							
Opuntia polyacantha	plains pricklypear				X		X	
Opuntia whipplei	whipple cholla							
Pediocactus simpsonii	ball cactus							
Sclerocactus parviflorus	barrel cactus					X		
PARASITES								
Arceuthobium campylopodum	dwarf mistletoe							
ALGAE								
Nostoc flagelliforme	blue green algae		X					
AGAVOIDS								
Yucca angustissima	Spanish bayonet				X			X
Yucca baccata	banana yucca				X			

SPECIES	COMMON NAME	SYNONYM	J10 SAGE
NATIVE ANNUAL & BIENNIAL FORBS			
Arenaria hookeri	Hooker sandwort		
Aster canescens	hoary tansyaster	Machaeranthera canescens	
Chaenactis stevioides	pincushion		
Chenopodium berlandieri	pitseed goosefoot		
Chenopodium fremontii	Fremont goosefoot		
Chenopodium hians	maple-leaved goosefoot	C. hybridum	
Chenopodium glaucum	oak-leaved goosefoot		
Chenopodium leptophyllum	narrowleaf goosefoot		
Cryptantha crassisepala	cryptantha		
Cryptantha minima	small hiddenflower		
Descurainia pinnata	pinnate tansy-mustard		
Descurainia richardsonii	Richardson tansy-mustard		
Draba cuneifolia	whitlowgrass		
Draba reptans	whitlowwort		
Erysimum asperum	wallflower		
Gilia aggregata	skyrocket gilia		
Gilia pumila	gilia	Ipomopsis pumila	X
Gilia sinuata	floccose gilia	G. inconspicua	X
Gilia sp.	gilia		
Lappula redowskii	bluebur stickseed		X
Lappula texana	stickseed	L. marginata	
Linanthus aureus	yellow gilia	Gilia aurea	X
Linum puberulum	yellow flax		
Lupinus brevicaulus	shortstem lupine		
Mentzelia albicaulis	blazingstar		
Oenothera albicaulis	prairie evening primrose		X
Phacelia crenulata	phacelia		
Plantago purshii	woolly plantain		X
Townsendia incana	townsendia		X
INTRODUCED ANNUAL & BIENNIAL FORBS			
Chenopodium album	common lambsquarter		
Chenopodium sp.	goosefoot		
Euphorbia sp.	spurge		
Kochia scoparia	fireweed summercypress		
Salsola kali	Russian thistle		
Sisymbrium altissimum	tumble mustard		
Solanum sarachoides	South American nightshade		
Tragopogon dubius	goat's beard		

SPECIES	COMMON NAME	SYNONYM	J10 SAGE
NATIVE ANNUAL GRASSES			
Festuca octoflora	six-weeks fescue		X
Munroa squarrosa	false buffalograss		
INTRODUCED ANNUAL GRASSES			
Bromus tectorum	cheatgrass		
NATIVE PERENNIAL FORBS			
Allium macropetalum	largeflowered onion		X
Arabis lignifera	woody rockcress		
Asclepias asperula	creeping milkweed		
Asclepias involucrata	Eastwood milkweed	A. macrosperma eastw.	
Aster arenosus	white aster	Leucelene ericoides	X
Astragalus calycosus var. scapiosus	Torrey milkvetch		
Astragalus praelongus	stinking milkvetch		
Astragalus wingatanus	Fort Wingate milkvetch		
Bahia oppositifolia	Plains bahia	Picradeniopsis oppositifolia	
Calochortus nuttallii	sego lily		
Clematis ligusticifolia	Western virginsbower		
Cryptantha flavoculata	cryptantha		
Cryptantha sp.	cryptantha		X
Cymopterus purpurascens	spring parsley		
Cymopterus purpureus	purple wafer-parsnip		
Delphinium scaposum	barestem larkspur		X
Eriogonum alatum	winged eriogonum		
Eriogonum leptophyllum	buckwheat		
Eriogonum sp.	wild buckwheat		
Eriogonum umbellatum	sulfur wild buckwheat		
Euphorbia fendleri	Fendler spurge		X
Haplopappus armerioides	thrifty goldenweed		
Haplopappus nuttallii	Nuttall goldenweed		
Haplopappus sp.	goldenweed		
Hymenopappus pauciflorus	fineleaf bitterweed		
Lesquerella intermedia	bladderpod		
Lithospermum incisum	puccoon		
Lygodesmia juncea	skeletonweed		
Mirabilis multiflora	colorado four o'clock		
Mirabilis oxybaphoides	short-calyx four o'clock		

SPECIES	COMMON NAME	SYNONYM	J10 SAGE
NATIVE PERENNIAL FORBS (cont)			
Oenothera coronopifolia	evening-primrose		
Oxybaphus linearis	narrowleaf umbrellawort		
Pedicularis centrantherum	wood betony		
Penstemon barbatus	beardlip penstemon		
Penstemon eatoni	Eaton penstemon		
Penstemon linarioides	mat penstemon		
Penstemon sp.	penstemon		
Phlox longifolia	longleaf phlox		
Phlox sp.	phlox		
Psilostrophe sparsiflora	greenstem paperflower		
Solidago petradoria	rock goldenrod	Petradoria pumila	
Sphaeralcea coccinea	scarlet globemallow		X
Sphaeralcea parvifolia	littleleaf globemallow		
Stanleya pinnata	desert plume		
Stephanomeria runcinata	desert wirelettuce		
Streptanthus cordatus	twistflower		
Townsendia exscapa	ground daisy		X
Townsendia sp.	townsendia		
INTRODUCED PERENNIAL FORBS			
Corydalis aurea	scrambled eggs		
Rumex crispus	curly-leaf dock		
NATIVE PERENNIAL GRASSES (cool)			
Agropyron dasystachyum	thickspike wheatgrass		
Agropyron smithii	Western wheatgrass		X
Carex occidentalis	Western sedge		
Oryzopsis hymenoides	Indian ricegrass		X
Poa fendleriana	mutton grass		X
Sitanion jubatum	big squirreltail		
Sitanion longifolium	bottlebrush squirreltail	Sitanion hystrix	X
Stipa comata	needle-and-thread grass		X
INTRODUCED PERENNIAL GRASSES (cool)			
Elymus junceus	Russian wildrye		
Poa compressa	Canada bluegrass		
Puccinellia distans	European alkaligrass		

SPECIES	COMMON NAME	SYNONYM	J10 SAGE
NATIVE PERENNIAL GRASSES (warm)			
Aristida purpurea	purple three-awn		
Bouteloua gracilis	blue grama		X
Hilaria jamesii	galleta		X
Sporobolus airoides	alkali sacaton		
Sporobolus cryptandrus	sand dropseed		
NATIVE SUBSHRUBS			
Artemisia frigida	fringed sagewort		X
Chrysothamnus depressus	dwarf rabbitbrush		
Chrysothamnus greenei	Greene rabbitbrush		X
Eriogonum aureum	slenderbush wild buckwheat	E. microthecum	X
Eriogonum corymbosum	buckwheat		
Eurotia lanata	winterfat	Ceratoides lanata	X
Gutierrezia sarothrae	broom snakeweed		X
Haplopappus drummondii	Drummond goldenweed		
Leptodactylon pungens	granite pricklygilia		X
Polygala subspinosa	cushion milkwort		
Senecio douglasii var. longilobus	threadleaf groundsel		
NATIVE SHRUBS			
Artemisia tridentata	big sagebrush		X
Atriplex canescens	four-wing saltbush		X
Atriplex confertifolia	shadscale saltbush		
Chrysothamnus nauseosus	rubber rabbitbrush		X
Chrysothamnus viscidiflorus	sticky-leaved rabbitbrush		X
Cowania mexicana	cliff rose	Purshia stansburiana	
Ephedra viridis	mountain joint-fir		
Forestiera neomexicana	desert olive		
Haplopappus laricifolius	turpentine-bush	Ericameria laricifolius	
Lycium pallidum	rabbitthorn		
Purshia tridentata	antelope bitterbrush		
Sarcobatus vermiculatus	black greasewood		X
Shepherdia rotundifolia	roundleaf buffaloberry		
Tetradymia canescens	gray feltthorn		X
INTRODUCED SHRUBS			
Tamarix pentandra	saltcedar		

SPECIES	COMMON NAME	SYNONYM	J10 SAGE
NATIVE TREES			
Juniperus osteosperma	Utah juniper		X
Pinus edulis	Colorado pinyon		X
Quercus gambelii	Gambel oak		
MOSSES			
Moss	moss		
Polytrichum piliferum	moss		
LICHENS			
Collema tenax	lichen		
Lecidea decipiens	lichen		
Lecidea sp.	lichen		
Lichen	lichen		
Parmelia chlorochroa	lichen	Xanthoparmelia chlorochroa	X
SUCCULENTS			
Echinocereus triglochidiatus var. mojavensis	Mojave claret-cup		
Mammilaria microcarpa	pincushion cactus		
Mammillaria sp.	pincushion cactus		
Opuntia fragilis var. fragilis	little pricklypear		
Opuntia macrorhiza	thickroot pricklypear		X
Opuntia phaeacantha	pricklypear		
Opuntia polyacantha	plains pricklypear		
Opuntia whipplei	whipple cholla		
Pediocactus simpsonii	ball cactus		
Sclerocactus parviflorus	barrel cactus		
PARASITES			
Arceuthobium campylopodum	dwarf mistletoe		
ALGAE			
Nostoc flagelliforme	blue green algae		
AGAVOIDS			
Yucca angustissima	Spanish bayonet		
Yucca baccata	banana yucca		

SPECIES	COMMON NAME	SYNONYM	J13/14 PJUN	J13/14 SAGE	J15 PJUN	J15 SAGE	J28 PJUN	J28 SAGE
NATIVE ANNUAL & BIENNIAL FORBS								
Arenaria hookeri	Hooker sandwort							
Aster canescens	hoary tansyaster	Machaeranthera canescens					X	X
Chaenactis stevioides	pincushion							
Chenopodium berlandieri	pitseed goosefoot					X	X	
Chenopodium fremontii	Fremont goosefoot						X	
Chenopodium hians	maple-leaved goosefoot	C. hybridum						X
Chenopodium glaucum	oak-leaved goosefoot							X
Chenopodium leptophyllum	narrowleaf goosefoot						X	X
Cryptantha crassisepala	cryptantha			X				X
Cryptantha minima	small hiddenflower							
Descurainia pinnata	pinnate tansy-mustard				X	X	X	X
Descurainia richardsonii	Richardson tansy-mustard						X	X
Draba cuneifolia	whitlowgrass							
Draba reptans	whitlowwort							
Erysimum asperum	wallflower							
Gilia aggregata	skyrocket gilia							
Gilia pumila	gilia	Ipomopsis pumila				X		X
Gilia sinuata	floccose gilia	G. inconspicua				X		
Gilia sp.	gilia							
Lappula redowskii	bluebur stickseed		X	X	X	X	X	X
Lappula texana	stickseed	L. marginata						
Linanthus aureus	yellow gilia	Gilia aurea						
Linum puberulum	yellow flax		X	X	X	X		
Lupinus brevicaulus	shortstem lupine							
Mentzelia albicaulis	blazingstar							
Oenothera albicaulis	prairie evening primrose							
Phacelia crenulata	phacelia							
Plantago purshii	woolly plantain							
Townsendia incana	townsendia			X				
INTRODUCED ANNUAL & BIENNIAL FORBS								
Chenopodium album	common lambsquarter					X	X	X
Chenopodium sp.	goosefoot							
Euphorbia sp.	spurge							
Kochia scoparia	fireweed summercypress							
Salsola kali	Russian thistle							X
Sisymbrium altissimum	tumble mustard							
Solanum sarachoides	South American nightshade							X
Tragopogon dubius	goat's beard					X		

SPECIES	COMMON NAME	SYNONYM	J13/14 PJUN	J13/14 SAGE	J15 PJUN	J15 SAGE	J28 PJUN	J28 SAGE
NATIVE ANNUAL GRASSES								
Festuca octoflora	six-weeks fescue					X	X	X
Munroa squarrosa	false buffalograss							X
INTRODUCED ANNUAL GRASSES								
Bromus tectorum	cheatgrass						X	X
NATIVE PERENNIAL FORBS								
Allium macropetalum	largeflowered onion							
Arabis lignifera	woody rockcress						X	
Asclepias asperula	creeping milkweed							
Asclepias involucrata	Eastwood milkweed	A. macrosperma eastw.						
Aster arenosus	white aster	Leucelene ericoides	X	X	X	X	X	X
Astragalus calycosus var. scapiosus	Torrey milkvetch				X			
Astragalus praelongus	stinking milkvetch							
Astragalus wingatanus	Fort Wingate milkvetch				X		X	
Bahia oppositifolia	Plains bahia	Picradeniopsis oppositifolia						
Calochortus nuttallii	sego lily		X	X		X		
Clematis ligusticifolia	Western virginsbower							
Cryptantha flavoculata	cryptantha				X		X	
Cryptantha sp.	cryptantha			X	X			
Cymopterus purpurascens	spring parsley		X	X			X	
Cymopterus purpureus	purple wafer-parsnip			X	X	X		
Delphinium scaposum	barestem larkspur							
Eriogonum alatum	winged eriogonum							
Eriogonum leptophyllum	buckwheat			X				
Eriogonum sp.	wild buckwheat							
Eriogonum umbellatum	sulfur wild buckwheat			X	X			
Euphorbia fendleri	Fendler spurge		X	X		X	X	
Haplopappus armerioides	thrifty goldenweed							
Haplopappus nuttallii	Nuttall goldenweed							
Haplopappus sp.	goldenweed							
Hymenopappus pauciflorus	fineleaf bitterweed							
Lesquerella intermedia	bladderpod						X	
Lithospermum incisum	puccoon							
Lygodesmia juncea	skeletonweed							
Mirabilis multiflora	colorado four o'clock						X	
Mirabilis oxybaphoides	short-calyx four o'clock						X	

SPECIES	COMMON NAME	SYNONYM	J13/14 PJUN	J13/14 SAGE	J15 PJUN	J15 SAGE	J28 PJUN	J28 SAGE
NATIVE PERENNIAL FORBS (cont)								
Oenothera coronopifolia	evening-primrose					X		
Oxybaphus linearis	narrowleaf umbrellawort		X	X	X		X	
Pedicularis centrantherum	wood betony						X	
Penstemon barbatus	beardlip penstemon						X	
Penstemon eatoni	Eaton penstemon							
Penstemon linarioides	mat penstemon						X	
Penstemon sp.	penstemon							X
Phlox longifolia	longleaf phlox					X	X	X
Phlox sp.	phlox		X					
Psilostrophe sparsiflora	greenstem paperflower							
Solidago petradoria	rock goldenrod	Petradoria pumila					X	
Sphaeralcea coccinea	scarlet globemallow		X	X	X	X	X	X
Sphaeralcea parvifolia	littleleaf globemallow						X	
Stanleya pinnata	desert plume							
Stephanomeria runcinata	desert wirelettuce		X					
Streptanthus cordatus	twistflower							
Townsendia exscapa	ground daisy						X	X
Townsendia sp.	townsendia							
INTRODUCED PERENNIAL FORBS								
Corydalis aurea	scrambled eggs							
Rumex crispus	curly-leaf dock							
NATIVE PERENNIAL GRASSES (cool)								
Agropyron dasystachyum	thickspike wheatgrass					X		
Agropyron smithii	Western wheatgrass					X	X	X
Carex occidentalis	Western sedge							
Oryzopsis hymenoides	Indian ricegrass		X	X	X	X	X	X
Poa fendleriana	mutton grass				X		X	
Sitanion jubatum	big squirreltail				X	X	X	X
Sitanion longifolium	bottlebrush squirreltail	Sitanion hystrix	X		X		X	X
Stipa comata	needle-and-thread grass		X	X	X	X	X	X
INTRODUCED PERENNIAL GRASSES (cool)								
Elymus junceus	Russian wildrye					X		
Poa compressa	Canada bluegrass							
Puccinellia distans	European alkaligrass							

SPECIES	COMMON NAME	SYNONYM	J13/14 PJUN	J13/14 SAGE	J15 PJUN	J15 SAGE	J28 PJUN	J28 SAGE
NATIVE PERENNIAL GRASSES (warm)								
Aristida purpurea	purple three-awn		X	X	X			
Bouteloua gracilis	blue grama		X	X	X	X	X	X
Hilaria jamesii	galleta		X	X	X	X	X	X
Sporobolus airoides	alkali sacaton			X				
Sporobolus cryptandrus	sand dropseed		X			X	X	X
NATIVE SUBSHRUBS								
Artemisia frigida	fringed sagewort							
Chrysothamnus depressus	dwarf rabbitbrush		X					
Chrysothamnus greenei	Greene rabbitbrush		X	X		X	X	X
Eriogonum aureum	slenderbush wild buckwheat	E. microthecum	X		X		X	
Eriogonum corymbosum	buckwheat							
Eurotia lanata	winterfat	Ceratoides lanata		X		X		
Gutierrezia sarothrae	broom snakeweed		X	X	X	X	X	X
Haplopappus drummondii	Drummond goldenweed		X	X	X			
Leptodactylon pungens	granite pricklygilia		X					
Polygala subspinosa	cushion milkwort		X					
Senecio douglasii var. longilobus	threadleaf groundsel			X			X	
NATIVE SHRUBS								
Artemisia tridentata	big sagebrush		X	X	X	X	X	X
Atriplex canescens	four-wing saltbush		X			X	X	X
Atriplex confertifolia	shadscale saltbush		X	X		X		
Chrysothamnus nauseosus	rubber rabbitbrush		X			X	X	
Chrysothamnus viscidiflorus	sticky-leaved rabbitbrush		X	X	X	X	X	X
Cowania mexicana	cliff rose	Purshia stansburiana			X		X	
Ephedra viridis	mountain joint-fir				X			
Forestiera neomexicana	desert olive							
Haplopappus laricifolius	turpentine-bush	Ericameria laricifolius					X	
Lycium pallidum	rabbitthorn		X				X	
Purshia tridentata	antelope bitterbrush							
Sarcobatus vermiculatus	black greasewood			X				X
Shepherdia rotundifolia	roundleaf buffaloberry							
Tetradymia canescens	gray feltthorn							
INTRODUCED SHRUBS								
Tamarix pentandra	saltcedar							X

SPECIES	COMMON NAME	SYNONYM	J13/14 PJUN	J13/14 SAGE	J15 PJUN	J15 SAGE	J28 PJUN	J28 SAGE
NATIVE TREES								
Juniperus osteosperma	Utah juniper		X	X	X	X	X	
Pinus edulis	Colorado pinyon		X		X	X	X	X
Quercus gambelii	Gambel oak							
MOSSES								
Moss	moss		X		X	X		X
Polytrichum piliferum	moss				X		X	
LICHENS								
Collema tenax	lichen				X			
Lecidea decipiens	lichen				X			
Lecidea sp.	lichen				X			
Lichen	lichen							
Parmelia chlorochroa	lichen	Xanthoparmelia chlorochroa						X
SUCCULENTS								
Echinocereus triglochidiatus var. mojavensis	Mojave claret-cup						X	
Mammilaria microcarpa	pincushion cactus							
Mammillaria sp.	pincushion cactus							
Opuntia fragilis var. fragilis	little pricklypear							
Opuntia macrorhiza	thickroot pricklypear		X	X	X			X
Opuntia phaeacantha	pricklypear						X	
Opuntia polyacantha	plains pricklypear							
Opuntia whipplei	whipple cholla		X	X	X			
Pediocactus simpsonii	ball cactus			X			X	
Sclerocactus parviflorus	barrel cactus							
PARASITES								
Arceuthobium campylopodum	dwarf mistletoe							
ALGAE								
Nostoc flagelliforme	blue green algae							
AGAVOIDS								
Yucca angustissima	Spanish bayonet		X		X		X	
Yucca baccata	banana yucca							

SPECIES	COMMON NAME	SYNONYM	N12/N99 NORTH/SOUTH PJUN	N12/N99 NORTH/SOUTH SAGE	N9 PJUN	N10 PJUN
NATIVE ANNUAL & BIENNIAL FORBS						
Arenaria hookeri	Hooker sandwort					
Aster canescens	hoary tansyaster	Machaeranthera canescens		X		
Chaenactis stevioides	pincushion					X
Chenopodium berlandieri	pitseed goosefoot					
Chenopodium fremontii	Fremont goosefoot		X		X	X
Chenopodium hians	maple-leaved goosefoot	C. hybridum				
Chenopodium glaucum	oak-leaved goosefoot					
Chenopodium leptophyllum	narrowleaf goosefoot			X		
Cryptantha crassisepala	cryptantha				X	
Cryptantha minima	small hiddenflower					
Descurainia pinnata	pinnate tansy-mustard		X	X	X	X
Descurainia richardsonii	Richardson tansy-mustard				X	
Draba cuneifolia	whitlowgrass				X	
Draba reptans	whitlowwort				X	
Erysimum asperum	wallflower					X
Gilia aggregata	skyrocket gilia				X	
Gilia pumila	gilia	Ipomopsis pumila				
Gilia sinuata	floccose gilia	G. inconspicua		X		X
Gilia sp.	gilia				X	
Lappula redowskii	bluebur stickseed		X	X	X	X
Lappula texana	stickseed	L. marginata				
Linanthus aureus	yellow gilia	Gilia aurea				
Linum puberulum	yellow flax					
Lupinus brevicaulus	shortstem lupine					
Mentzelia albicaulis	blazingstar					
Oenothera albicaulis	prairie evening primrose					
Phacelia crenulata	phacelia				X	
Plantago purshii	woolly plantain					
Townsendia incana	townsendia					
INTRODUCED ANNUAL & BIENNIAL FORBS						
Chenopodium album	common lambsquarter				X	
Chenopodium sp.	goosefoot				X	
Euphorbia sp.	spurge					
Kochia scoparia	fireweed summercypress					
Salsola kali	Russian thistle					
Sisymbrium altissimum	tumble mustard			X		
Solanum sarachoides	South American nightshade					
Tragopogon dubius	goat's beard					

SPECIES	COMMON NAME	SYNONYM	N12/N99 NORTH/SOUTH PJUN	N12/N99 NORTH/SOUTH SAGE	N9 PJUN	N10 PJUN
NATIVE ANNUAL GRASSES						
Festuca octoflora	six-weeks fescue					
Munroa squarrosa	false buffalograss					
INTRODUCED ANNUAL GRASSES						
Bromus tectorum	cheatgrass		X		X	X
NATIVE PERENNIAL FORBS						
Allium macropetalum	largeflowered onion					
Arabis lignifera	woody rockcress				X	
Asclepias asperula	creeping milkweed				X	
Asclepias involucrata	Eastwood milkweed	A. macrosperma eastw.				
Aster arenosus	white aster	Leucelene ericoides	X	X	X	X
Astragalus calycosus var. scapiosus	Torrey milkvetch					X
Astragalus praelongus	stinking milkvetch					
Astragalus wingatanus	Fort Wingate milkvetch		X		X	X
Bahia oppositifolia	Plains bahia	Picradeniopsis oppositifolia		X		
Calochortus nuttallii	sego lily			X		X
Clematis ligusticifolia	Western virginsbower		X			
Cryptantha flavoculata	cryptantha		X			
Cryptantha sp.	cryptantha		X		X	X
Cymopterus purpurascens	spring parsley		X		X	X
Cymopterus purpureus	purple wafer-parsnip					
Delphinium scaposum	barestem larkspur					
Eriogonum alatum	winged eriogonum				X	X
Eriogonum leptophyllum	buckwheat					
Eriogonum sp.	wild buckwheat				X	
Eriogonum umbellatum	sulfur wild buckwheat		X		X	X
Euphorbia fendleri	Fendler spurge		X		X	
Haplopappus armerioides	thrifty goldenweed				X	
Haplopappus nuttallii	Nuttall goldenweed				X	X
Haplopappus sp.	goldenweed					
Hymenopappus pauciflorus	fineleaf bitterweed					
Lesquerella intermedia	bladderpod					
Lithospermum incisum	puccoon					X
Lygodesmia juncea	skeletonweed				X	
Mirabilis multiflora	colorado four o'clock		X		X	X
Mirabilis oxybaphoides	short-calyx four o'clock					

SPECIES	COMMON NAME	SYNONYM	N12/N99 NORTH/SOUTH PJUN	N12/N99 NORTH/SOUTH SAGE	N9 PJUN	N10 PJUN
NATIVE PERENNIAL FORBS (cont)						
Oenothera coronopifolia	evening-primrose					
Oxybaphus linearis	narrowleaf umbrellawort					X
Pedicularis centrantherum	wood betony		X		X	X
Penstemon barbatus	beardlip penstemon				X	X
Penstemon eatoni	Eaton penstemon				X	
Penstemon linarioides	mat penstemon		X		X	X
Penstemon sp.	penstemon					
Phlox longifolia	longleaf phlox			X		
Phlox sp.	phlox					
Psilostrophe sparsiflora	greenstem paperflower		X		X	
Solidago petradoria	rock goldenrod	Petradoria pumila	X		X	X
Sphaeralcea coccinea	scarlet globemallow			X	X	X
Sphaeralcea parvifolia	littleleaf globemallow					
Stanleya pinnata	desert plume		X		X	X
Stephanomeria runcinata	desert wirelettuce					
Streptanthus cordatus	twistflower		X		X	X
Townsendia exscapa	ground daisy					
Townsendia sp.	townsendia				X	
INTRODUCED PERENNIAL FORBS						
Corydalis aurea	scrambled eggs			X		
Rumex crispus	curly-leaf dock					
NATIVE PERENNIAL GRASSES (cool)						
Agropyron dasystachyum	thickspike wheatgrass					
Agropyron smithii	Western wheatgrass			X		
Carex occidentalis	Western sedge		X		X	X
Oryzopsis hymenoides	Indian ricegrass		X	X	X	X
Poa fendleriana	mutton grass		X		X	X
Sitanion jubatum	big squirreltail					
Sitanion longifolium	bottlebrush squirreltail	Sitanion hystrix	X	X	X	X
Stipa comata	needle-and-thread grass		X			X
INTRODUCED PERENNIAL GRASSES (cool)						
Elymus junceus	Russian wildrye					
Poa compressa	Canada bluegrass			X		
Puccinellia distans	European alkaligrass		X			

SPECIES	COMMON NAME	SYNONYM	N12/N99 NORTH/SOUTH PJUN	N12/N99 NORTH/SOUTH SAGE	N9 PJUN	N10 PJUN
NATIVE PERENNIAL GRASSES (warm)						
Aristida purpurea	purple three-awn					
Bouteloua gracilis	blue grama		X	X	X	X
Hilaria jamesii	galleta		X	X	X	X
Sporobolus airoides	alkali sacaton					
Sporobolus cryptandrus	sand dropseed			X		
NATIVE SUBSHRUBS						
Artemisia frigida	fringed sagewort		X	X		
Chrysothamnus depressus	dwarf rabbitbrush					
Chrysothamnus greenei	Greene rabbitbrush			X		X
Eriogonum aureum	slenderbush wild buckwheat	E. microthecum	X		X	X
Eriogonum corymbosum	buckwheat		X			
Eurotia lanata	winterfat	Ceratoides lanata		X		
Gutierrezia sarothrae	broom snakeweed		X	X	X	X
Haplopappus drummondii	Drummond goldenweed					
Leptodactylon pungens	granite pricklygilia					
Polygala subspinosa	cushion milkwort					
Senecio douglasii var. longilobus	threadleaf groundsel					
NATIVE SHRUBS						
Artemisia tridentata	big sagebrush		X	X	X	X
Atriplex canescens	four-wing saltbush		X	X	X	X
Atriplex confertifolia	shadscale saltbush					
Chrysothamnus nauseosus	rubber rabbitbrush			X	X	
Chrysothamnus viscidiflorus	sticky-leaved rabbitbrush		X	X	X	X
Cowania mexicana	cliff rose	Purshia stansburiana	X		X	X
Ephedra viridis	mountain joint-fir		X		X	X
Forestiera neomexicana	desert olive		X			
Haplopappus laricifolius	turpentine-bush	Ericameria laricifolius				X
Lycium pallidum	rabbitthorn					
Purshia tridentata	antelope bitterbrush				X	
Sarcobatus vermiculatus	black greasewood					
Shepherdia rotundifolia	roundleaf buffaloberry				X	
Tetradymia canescens	gray feltthorn					
INTRODUCED SHRUBS						
Tamarix pentandra	saltcedar			X		

SPECIES	COMMON NAME	SYNONYM	N12/N99 NORTH/SOUTH PJUN	N12/N99 NORTH/SOUTH SAGE	N9 PJUN	N10 PJUN
NATIVE TREES						
Juniperus osteosperma	Utah juniper		X		X	X
Pinus edulis	Colorado pinyon		X	X	X	X
Quercus gambelii	Gambel oak				X	X
MOSSES						
Moss	moss		X	X	X	X
Polytrichum piliferum	moss		X			
LICHENS						
Collema tenax	lichen					
Lecidea decipiens	lichen					
Lecidea sp.	lichen		X			
Lichen	lichen				X	
Parmelia chlorochroa	lichen	Xanthoparmelia chlorochroa	X	X		X
SUCCULENTS						
Echinocereus triglochidiatus var. mojavensis	Mojave claret-cup					X
Mammilaria microcarpa	pincushion cactus		X			
Mammillaria sp.	pincushion cactus				X	
Opuntia fragilis var. fragilis	little pricklypear					
Opuntia macrorhiza	thickroot pricklypear		X	X	X	
Opuntia phaeacantha	pricklypear					
Opuntia polyacantha	plains pricklypear		X		X	X
Opuntia whipplei	whipple cholla					
Pediocactus simpsonii	ball cactus		X			
Sclerocactus parviflorus	barrel cactus					
PARASITES						
Arceuthobium campylopodum	dwarf mistletoe				X	
ALGAE						
Nostoc flagelliforme	blue green algae					
AGAVOIDS						
Yucca angustissima	Spanish bayonet		X			X
Yucca baccata	banana yucca					X

APPENDIX 3

Black Mesa Mining Complex
Field Guide
To
Potentially Occurring Rare Plants
2003

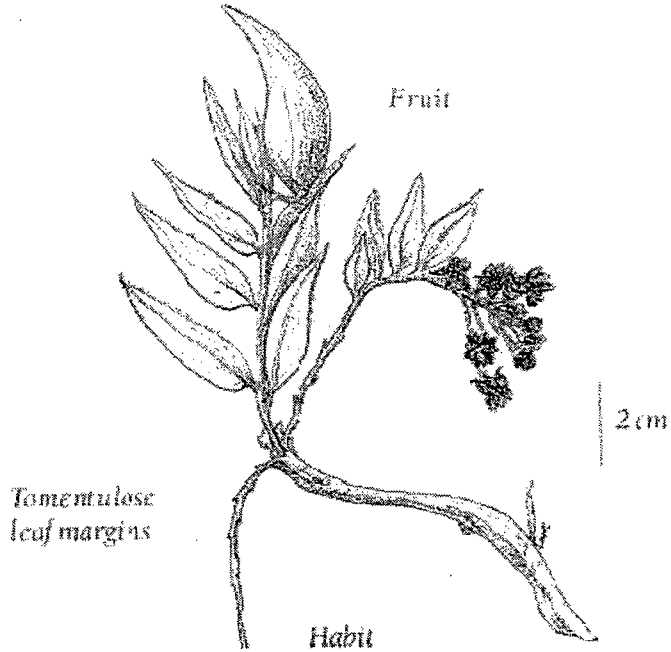
Black Mesa Mining Complex Field Guide to Potentially Occurring Rare Plants 2003

peeblesii, D. Roth/NNHP

Table of Contents

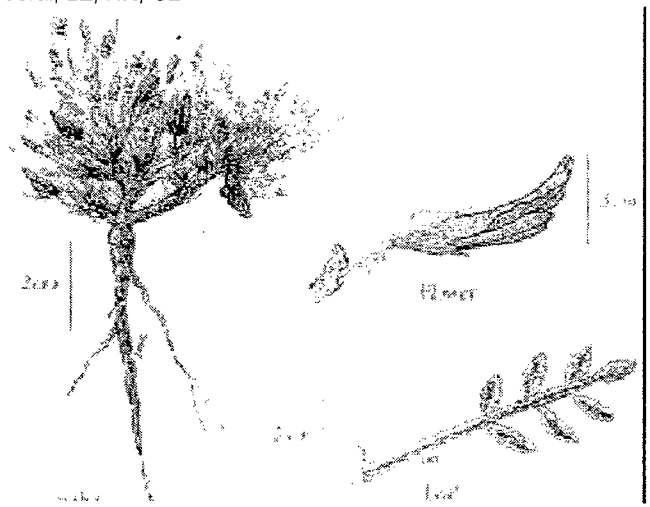
PINYON-JUNIPER WOODLAND SPECIES

***Asclepias sanjuanensis* – San Juan Milkweed**
Family: Asclepiadaceae
Synonyms: *A. unicialis* var. *ruthiae* (debated)
Status: Federal, 3B; NN, G4



Distinguishing characteristics
Milky white latex in stems and leaves; 2-7 branches, the auricles of the hood are erect, herbage pubescence is sparse, leaf shape lanceolate to broadly lanceolate.
Stems: woody taproot, 4-8 cm tall, prostrate to ascending
Leaves: 2-4 cm long, oblong-lanceolate, white tomentulose on leaf margins
Flower: inflorescence terminal; corolla reddish-violet; follicle 1/8-1/4 inch long
Blooms: Late April-early May
Lookalikes: *A. ruthiae* usu. has one branch, auricles of the hood not erect, herbage pubescence is dense, leaf shape broadly ovate to broadly lanceolate. *A. macrosperma* has tomentose herbage, pedicels, and calyx; leaves ovate-lanceolate to nearly orbicular; stems 5-15 cm long.
Habitat: grows on sandy benches and hills near the Chaco River, NM in **pinyon-juniper woodland** and Great Basin grassland communities

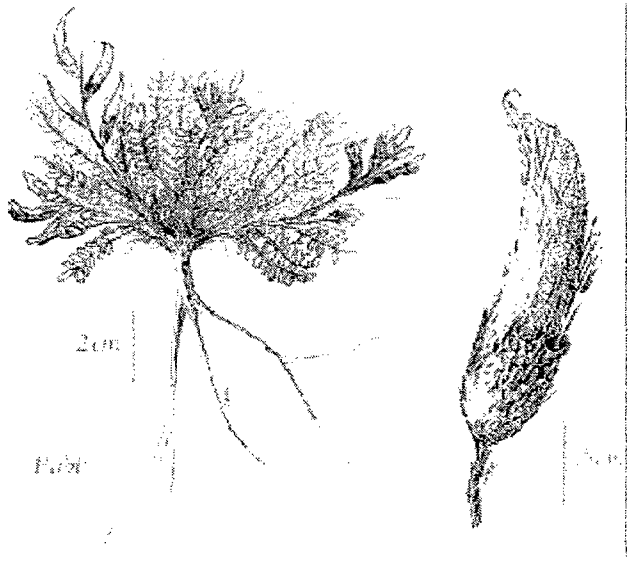
***Astragalus humillimus* – Mancos milkvetch**
Family: Fabaceae
Synonyms: *Tragacantha humillima, Phaca humillima*
Status: Federal, LE; NN, G2



Distinguishing Characteristics:
Tufted perennial forming clumps up to 30 cm across
Stems: **only Astragalus in the area with persistent spiny leaf petioles**, up to 1 cm long.
Pod: spreading, egg shaped, ellipsoid, 4.5 mm long, 2 mm wide
Leaves: crowded, up to 4 cm long, 7-11 oval leaflets, 0.7-2 mm long
Flower: branches short, 1-3 flowers, petals lavender to purplish, conspicuous lighter colored spot in the throat of the corolla tube; banner 7-10 mm long; keel and banner petal 6-8 mm long; calyx, 3mm long
Phenology: flowers late april to early may, fruits june to early july.
Lookalikes: *A. deterior* and *A. calycosus* var. *scaposus* have flaccid leaf petioles and longer, oblong, or narrowly ellipsoid pods. *A. micromerius* doesn't have persistent spiny leaf stalks.
Habitat: ledges and mesa tops in slickrock communities / **pinyon-juniper** woodlands of the Mesa Verde Group, often in cracks in the sandstone substrate or in shallow pockets of sandy soil. 5,000-5,850 ft in elevation.

Astragalus naturitensis **– Naturita milkvetch**
Family: Fabaceae
Synonyms: *A. arientinus* var. *stipularis*
Status: Federal, 3C (more abundant than prev. thought); NN, G4

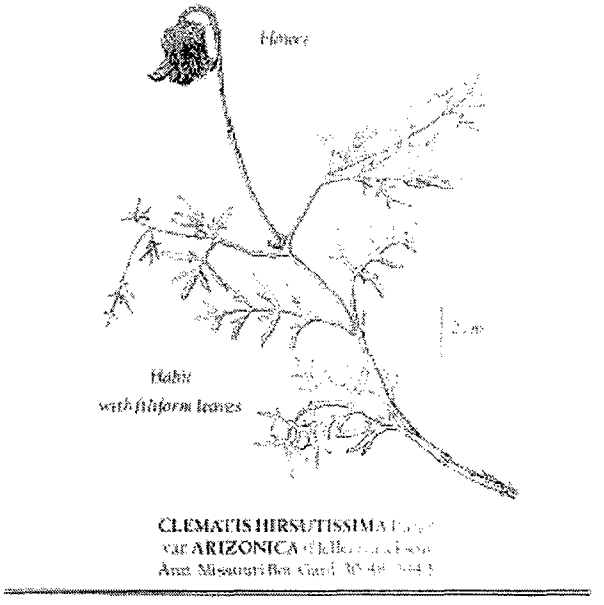
Distinguishing Characteristics:
Low growing, miniature spreading perennial about 10 cm tall
Stems: ascending, 2-6 cm long
Calyx: 4-8 mm, cylindrical, mixed white and black pubescent, lobes 1-1.5 mm
Pod: leathery, less than 2 cm long, more than twice as long as wide, widely spreading, covered with short, stiff, flat-lying hairs, **straight except for beak**, usually red mottled.
Leaves: basal, pinnate with 9-15 leaflets, leaves 2-7 mm, clustered, obovate to elliptic, mostly folded, often glabrate above, stipules free
Peduncles: scapose, 2-7 cm, wiith 4-9 subcapitate or briefly racemose ascending flowers
Flowers: 10-15 mm long, bi-color banner white with lilac, keel purple spotted, and wings reddish purple or purple tipped
Blooms: April to early June / Fruits: late May to June



Lookalikes: *A. deterior* has yellow-white flowers, *A. desperatus* has smaller flowers and loosely hirsute pods of broader and shorter outline, *A. monumentalis* var. *cottamii* has firm-walled, dorsiventrally compressed, unilocular pods, *A. humillimus* has persistent, spiny rachises.
Habitat: Sandstone mesas, ledges, crevices and slopes in **pinyon-juniper woodlands**. 5,000-7,000 ft in elevation.

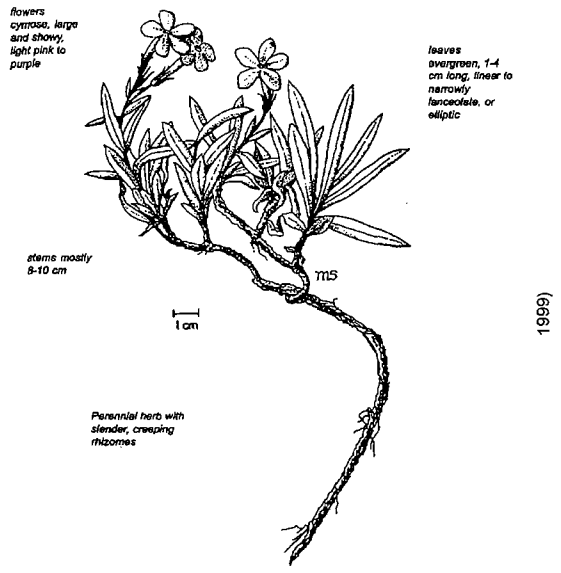
Clematis hirsutissima **var. *arizonica* – Arizona leather flower**
Family: Ranunculaceae
Synonym: *C. arizonica, C. h.* var. *hirsutissima*
Status: Federal, none, NN, G4

Distinguishing characteristics
Herbaceous perennial, 20-70 cm high
Fruit: head of achenes, each bearing a 4-6 cm plumose style
Flowers: nodding, solitary at the end of ea. Stem, 2-4 cm long
No petals, but w/ 4, thick purplish sepals, numerous stamens and pistils
Stems: erect from a somewhat woody base, ~5 cm to 1st branch
Leaves: pubescent to nearly glabrous, pinnately compound w/ 7-13 leaflets, these divisions narrowly linear, usually 1-2 mm, but rarely up to 12 mm
Blooms: Late April to June, Fruits July to August



Lookalikes: other *Clematis* are vine forming. *C. hirsutissima* (no variety) has more spreading petioles, narrower almost filiform leaflets (1-2mm wide), and mostly smaller flowers (sepals less than or equal to 2.5 cm long).
Habitat: moist mtn meadows, prairies, and open woods and thickets usually in limestone soils of **ponderosa pine and mixed conifer** forests, 6,800 to 9,000 ft

***Phlox cluteana* – Navajo Mountain Phlox**
Family: Polemoniaceae (Phlox family)
Status:



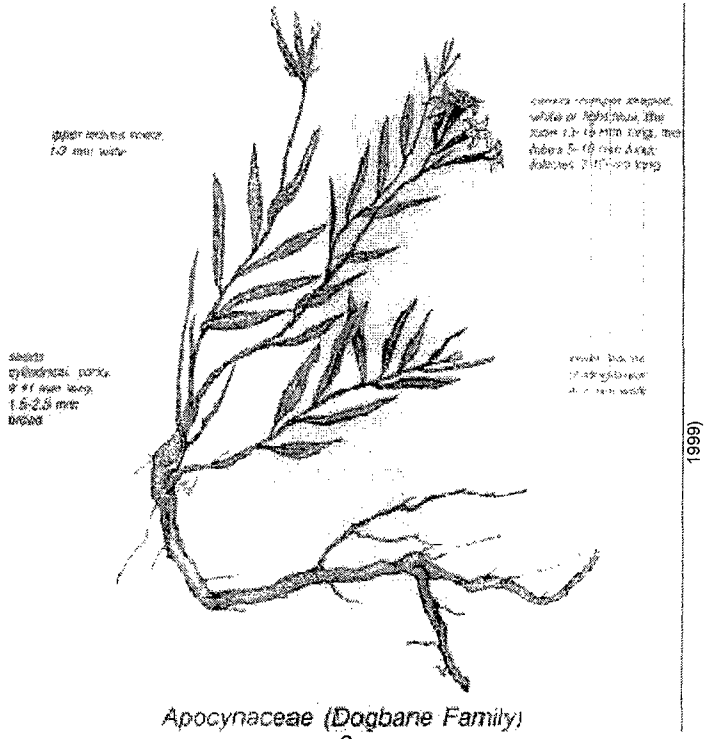
Polemoniaceae (Phlox Family)

Distinguishing characteristics
Plants with stems single or more/less clumped from subterranean, many-headed, subrhizomatous caudices. 4-12 cm tall
Stems: 8-10 cmm tall, sparsely to densely glandular pubescent
Leaves: 1-4 cm long, linear to narrowly lanceolate or elliptic, glabrous or ciliate or pubescent (like the stem) 2-5 mm wide
Flowers: cymose, large and showy, on pedicels 3-15 mm long, alone or 2 to several in terminal cymes; calyx: 7-9 mm long, intercostally flat; corolla tube: 14-18 mm long; lobes 7-10 mm long and nearly as wide, pink to lavender or white; stamens included or slightly exserted; style 9-14 mm long
Rhizomes: long, slender, terminating in clusters of evergreen leaves
Lookalikes: *P. longifolia* and *P. amabilis* have taproots and deciduous leaves
Habitat: Light to heavy shade under ponderosa pine, gambel oak, or **pinyon-juniper** in sandy soils with leaf litter; 6,400-10,400 ft

SHRUBLAND SPECIES

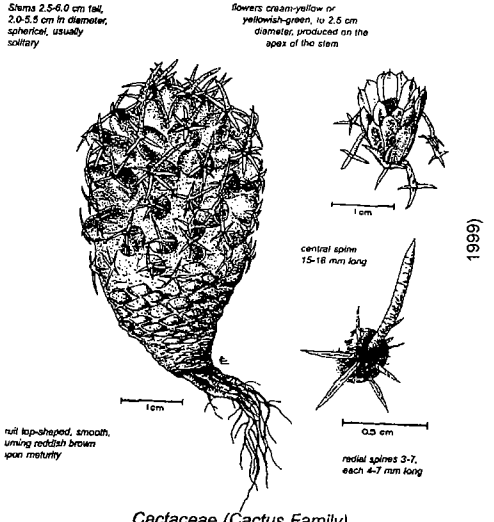
***Amsonia peeblesii* – Peebles blue star**
Family: Apocynaceae (Dogbane)
Status: Federal, none; NN, G4

Distinguishing Characteristics
Robust, herbaceous perennial, glabrous, 40-90 cm tall
Seeds: cylindrical, corky, 8-11mm long, 1.5-2.5 mm broad
Leaves: upper leaves linear, 1-2 mm wide
lower leaves oblong-linear, 4-9 mm wide
Flower: corolla trumpet shaped, white or light blue
tube 13-19 mm long
lobes 5-10 mm long
follicle 2-10 cm long
Blooms: May to June, leaves turn golden color in fall
Lookalikes: Glabrous form of *A. tomentosa* var. *stenophylla* has smaller flowers (7-12 mm long) and the follicles are moderately constricted between the seeds (*A. peeblesii* has smoothly cylindrical follicles)
Habitat: Little Colorado watershed; grows in **grasslands** and Great Basin **desertscrub** communities. Subtrate types range from strongly alkaline sedimentary conglomerates to volcanic cinders; 4,000-5,620 ft.



Apocynaceae (Dogbane Family)

***Pediocactus peeblesianus* var. *fickeiseniae* – Fickeisen plains cactus, Fickeisen pincushion cactus**

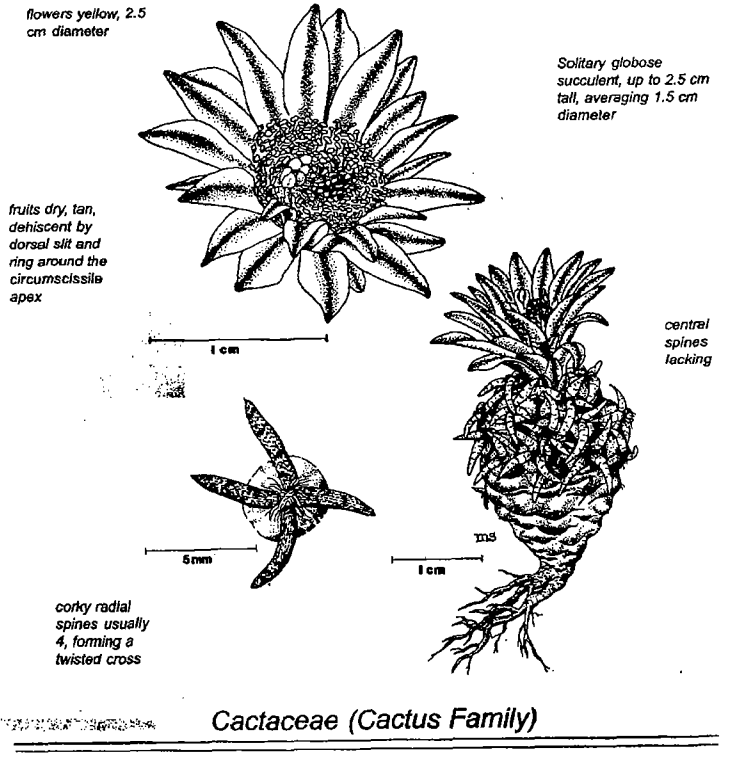


Family: Cactaceae
Synonyms: *Navajoa fickeisenii, Toumeya fickeisenii*
Status: Federal, Candidate; NN, G3

Distinguishing characteristics
The genus *Pediocactus* have no ribs, cylindric to globose stems, flowers <25mm in diameter, petals white or with pink or yellow at least on the midribs; fruit, dry, green, to tan/yellow, naked or scaly. *P. p.* var. *fickeiseniae* is a solitary or clustered cactus, globose 2.5-6 cm tall and 2-5.5 cm in diameter
Flowers: cream-yellow or yellowish-green, to 2.5 cm diameter, produced on the apex of the stem, petaloid perianth parts cream, yellow, or yellowish-green; outer perianth parts with pink or green midstripe; stamens yellow; stigma yellow.
Tubercles: 3-7 mm long, 4-6 mm broad
Aureoles: circular
Stems: 2.5-6 cm tall, 2-5.5 cm in diameter, spherical, usu. solitary
Central spine: **15-18 mm long, spongy,** white to pale gray, ascending, mostly 1 mm wide at base
Radial spines: 3-7, each 4-7 mm long, **spongy**, not obscuring the stem, long, white to pale gray, recurving
Fruit: top-shaped, smooth, turning reddish brown upon maturity
Blooms: April, retracts into the soil in drought
Lookalikes/Varieties: *P.p.* var. *peeblesianus* has no central spine and 4-5 radial spines. *P. simpsonii* has a smooth spine spreading at right angles to tubercles, tubercles have strait central spines, not ribbed
Habitat: gravelly limestone/gravelly loam in **desertscrub**; 4,300-5,450 ft.

***Pediocactus peeblesianus* var. *peeblesianus* – Navajo plains cactus**
Family: Cactaceae
Status: Federal, LE; NN, none

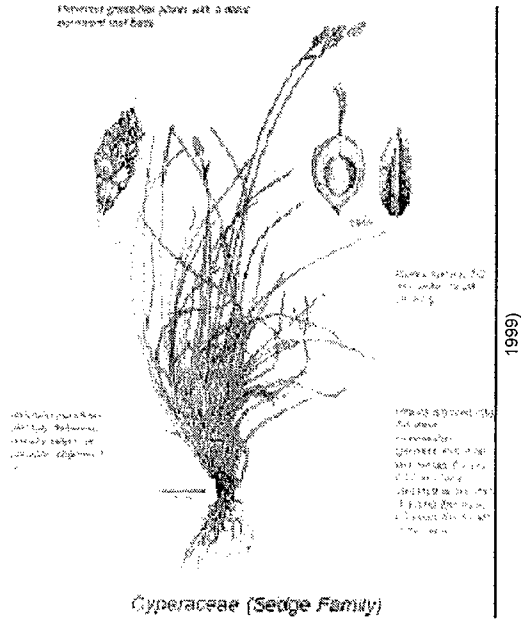
Distinguishing characteristics
Solitary globose succulent, up to 2.5 cm tall, averaging 1.5 cm diameter
Flowers: yellow, 2.5 cm in diameter
Central spines: **lacking**
Radial spines: corky, usu. 4, forming a twisted cross
Fruits: dry, tan, dehiscent by dorsal slit and ring around the circumscissile apex
Blooms: April, fruits May to June, retract during drought / dry
Lookalikes/varieties: *P. p.* var. *fickeiseniae* has a prominent central spine, more radial spines and grows larger. See above description of *P. simpsonii.*
Habitat: low hills in **desertscrub** and grassland; 5,100-5,650 ft.



SEEPS / STREAMS / HANGING GARDENS

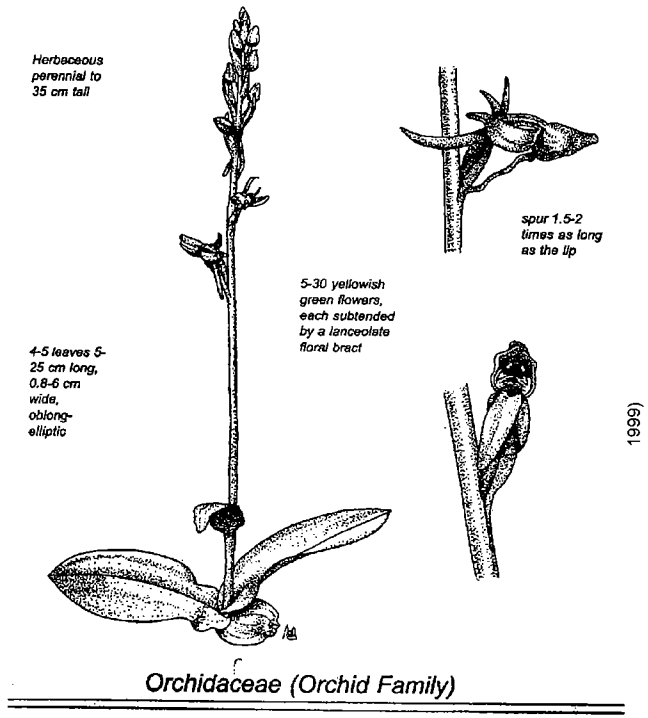
***Carex specuicola* – Navajo Sedge**
Family: Cyperaceae
Status: Federal, LT; NN, G3

Distinguishing characteristic
Perennial grass-like plant with a dried, reddish, persistent leaf base
Styles: 2-branched with lenticular achenes and 3-branched with trigonous achenes, 2-branched style is more common
Terminal spike: usu. gynaecandrous, short peduncled or sessile
Perigynea: nerveless or finely few-nerved, strongly flattened, papillose, broadly elliptic or obovate, stigmas 2 or 3
Leaves: narrow, 1-3 mm wide, 12-20 cm long
Flowers: grouped into 2-4 short, pedunculate spikelets with male and female flowers, 8-10 mm long, clustered at the end of a long thin stalk, 2-3 times the length of the leaves. Female flowers located above male flowers
Phenology: flowering and fruit set occur from spring to summer, most reproduction appears to be vegetative
Lookalikes: *C. aurea* does not have a strongly flattened perigynia or female flowers located above male flowers. *C. occidentalis* has slender, longer stems (20-70 cm); *C. geophila* has fertile stems shorter than most leaves, leaf blades 5-15 cm long (shorter)
Habitat: N. AZ, **seeps and hanging gardens**, on vertical Navajo sandstone cliffs and alcoves; 4,400-7,000 ft.

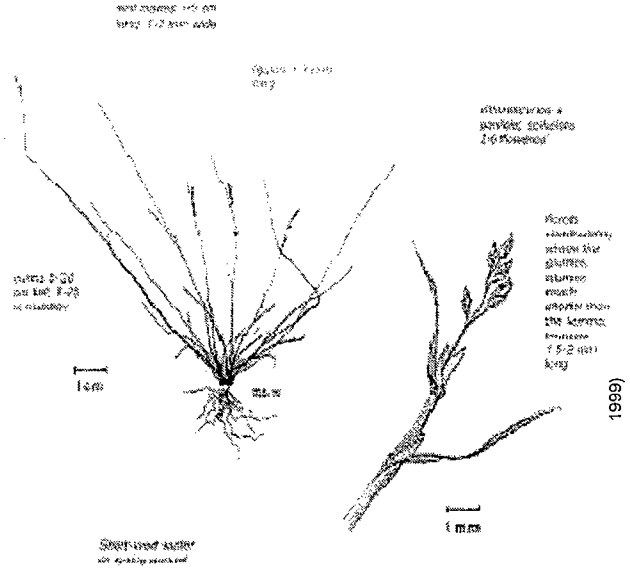


***Platanthera zothecina* – alcove bog orchid**
Family: Orchidaceae
Synonym: *Limnorchis zothecina, Habenaria zothecina*
Status: Federal, SC (species of concern); NN, G3

Distinguishing characteristics
Herbaceous perennial to 35 cm tall
Spur: 1.5-2 times as long as the lip
Inflorescence: 5-30 yellowish green flowers, each subtended by a lanceolate floral bract
Leaves: 4-5 leaves, 5-25 cm long, 0.8-6 cm wide, oblong-elliptic, appear late April to early May
Spike: develops in early June
Flowers: corolla tube, yellowish-green
Blooms: mid June-July
Capsules: mature in about one month
Lookalikes: *P. sparsiflora* has spur equal or slightly exceeding lip, less rounded basal leaves, and a less elliptic lip
Habitat: **seeps, streams, hanging gardens and wet canyon alcoves**, 5,000-9,000 ft. requires constant moisture, full to partial sun



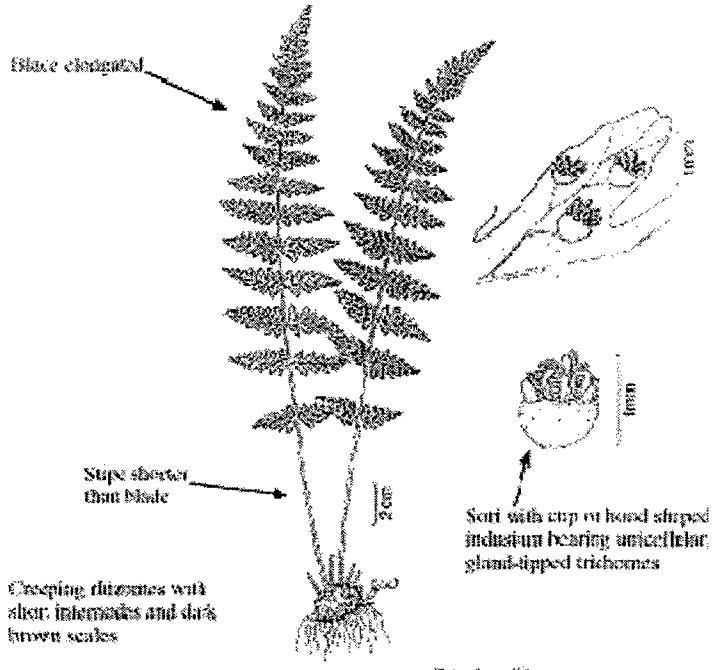
***Puccinellia parishii* – Parish's alkali grass**
Family: Poaceae
Status: Federal, SC; NN, G2



Poaceae (Grass Family)

Distinguishing characteristics
winter or spring **annual** dwarf grass, 5-28 cm tall
Leaves: blades 1-6 cm long, 1-2 mm wide; flat to slightly involute
Ligules: **1-3 mm long**
Inflorescence: narrow panicle; spikelets 2-6 flowered, 3-5 mm long
Florets: disarticulating above the glumes
Glumes: much shorter than the lemma, unequal, broad, strongly nerved, scarious margined
Lemma: 1.5-2 mm long, **pubescent on nerves only**, firm, obtuse
Culms: 5-28 cm tall; 1-25 in number
Flowers: April to May and June to September
Lookalikes: *P. fasciculata* and *P. airoides*. Both perennial; if hairy, hairs not confined to nerves of lemma; *P. fasciculata* is 20-50 cm tall (on average, taller); *P. airoides* is 15-80 cm tall (also taller, on average); *Poa annua* has boat shaped leaves
Habitat: Marshy ground along **seeps and streams**, saline or alkaline soil forming a white crust on the ground; associated with pinyon-juniper woodlands to desert communities, 2,950-6,070 ft.

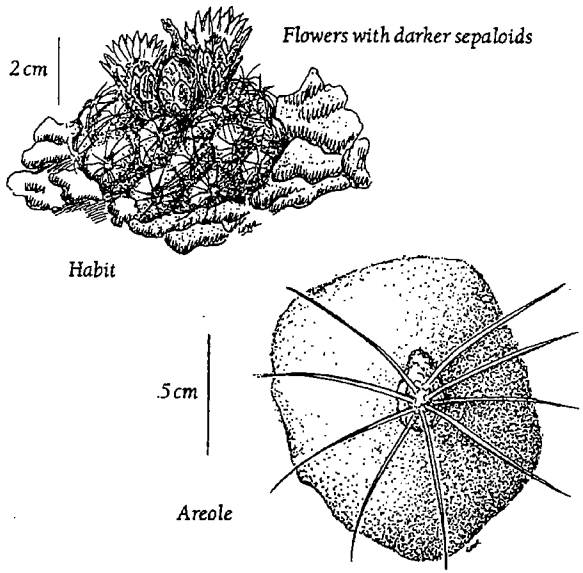
***Cystopteris utahensis* – Utah bladder-fern**
Family: Polypodiaceae
Status: Federal, none; NN, G4



Distinguishing characteristics
Stems: creeping, not cordlike, internodes short, heavily beset with old petiole bases, hairs absent; scales lanceolate
Fronds: monomorphic, clustered at stem apex, to 45 cm, nearly all bearing sori.
Petiole: green to straw colored; blade deltate, 2 pinnate-pinnatifid, usually widest at or near the base, apex short-attenuate, rachis and costae with unicellular, gland-tipped hairs
Phenology: sporulating summer to fall
Lookalikes: *C. fragilis* does not have small glands and scaly bulblets near the tip of the frond, as wells as dark scales on the underground stem made up of cells with very thick walls
Habitat: **seepages, crack, and ledges on cliffs**; on calcareous substrates including sandstone, limestone, and dacite. On the NN, known from sandstone cracks above the streambed, 4,200-8,800 ft.

BOTH SHRUB AND PINYON-JUNIPER

***Sclerocactus mesae-verdae* – Mesa Verde cactus**
Family: Cactaceae
Synonyms: *Coloradoa mesae-verdae, Echinocactus mesae-verdae, Pediocactus mesae-verdae*
Status: Federal, LT; NN, G3



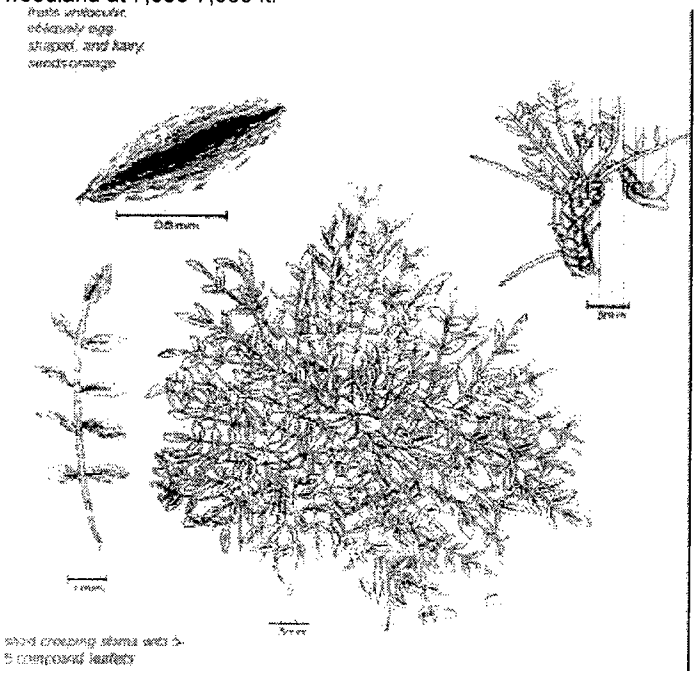
SCLEROCACTUS MESAE-VERDAE
(Boissevain *ex* Hill & Salisbury) L. Benson
Cact. and Succ. Jour. 38: 54. 1966.

Distinguishing characteristics
The genus *Sclerocactus* are subglobose, depressed-hemispheric, ovoid, obovoid, or cylindroid; ribs 8-17; one or more of lower central spines usu strongly hooked. *S. mesae-verdae* is~ 2 cm tall, above ground
Areole: 0.5 cm diameter
Stems: mostly solitary, sometimes in clusters, 3-11 cm tall, oval to depressed-globose
Central spines: none or rarely 1
Radial spines: 8-10
Flowers: cream to pink, born below but adjacent to apex of the stem
Fruit: green turning tan; oblong
Blooms: late April to early May
Lookalikes: *S. parviflorus* usu. has 4 central spines, green cylindroidal to elongate cylindroidal stems. *S. whipplei* is taller (stems 10-25 cm tall), has 1-3 or more central spines, 3-5 cm long, 1-3 or more radial spines usu obscure the stem, 5000-6000 ft.
Habitat: barren clay hills of Fruitland and Mancos shale formation

VERY UNLIKELY TO BE SEEN

***Astragalus cremnophylax* var. *cremnophylax* Barneby – Sentry milkvetch**
Family: Fabaceae
Status: Federal, none; NN, G4

Distinguishing characteristics
Dwarf, evergreen, perennial, mat forming herb, 2-25 cm in diameter
Flowers: tiny, pale pinkish-lilac, white tipped keep incurved 100-120 degrees, purple veined banner; borne on a raceme of 1-3 flowers, held slightly above the mat, less than 10mm long, immersed in leaves
Leaves: all diminutive, leaf stalk 2-5 mm, softly tipped; leaflets 3-7, leaves 3-10mm, crowded pinnate or subpalmate
Fruit: ascending, unilocular, deciduous ovoid/obliquely egg-shaped, and hairy. Seeds orange. Ovules 4-6, fruits May to June
Blooms: late April to May, rarely a 2nd flowering in fall
Lookalikes: *A. c.* var. *myriorrphaphis* has spinescent leaf bases; *A.c.* var. *hevronii* has larger flowers; and *A. calycosus* has larger leaflets and does not have unilocular fruits
Habitat: Grand Canyon NP in crevices and depressions w/shallow soils on Kaibab limestone on rim-rock benches at the canyon edge in **pinyon-juniper** woodland at 7,050-7,960 ft.



VERY UNLIKELY TO BE SEEN

***Astragalus cutleri* – Cutler's milkvetch**
Family: Fabaceae
Synonyms: *Astragalus preussii* var. *cutleri*
Status: Federal, LE; NN, G3

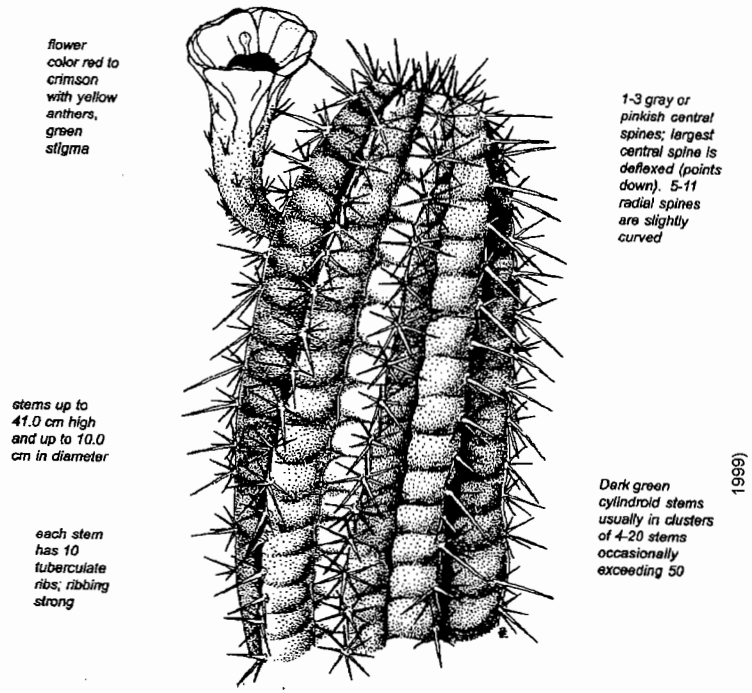
Distinguishing characteristics
Moderate, caulescent, short lived perennial, 10-35 mm long, from a woody caudex, pubescence affixed by its base
Flowers: 15-16 mm long; white or faintly blue tinged; ascending peduncles, 2-15 cm long; racemes, 3 to 22 flowered, axis 1-20 cm long in fruit; bracts,1.5-4 mm long; pedicels,1-5.5 mm long; bracteoles, 2; calyx, 6.4-12.3mm long; tube, 5.1-9.7 mm long, cylindric, thinly strigose, purple; teeth, 1.3-2.6 mm long, subulate
Fruit: pods thin textured, often drying straw colored, erect to ascending, stipitate, or subsessile; stipe, 2-7 mm long, oblong-ellipsoid, inflated, 12-34 mm long, 6-13 mm thick, glabrous or puberulent , stiffly papery to leathery,uniloculular; ovules 20-44
Leaves: 3.5-13 cm long
Leaflets: few, 5-13, 7-12 mm wide, obovate to obchordate to oblong, narrrowly elliptic, lanceolate, or linear, emarginate to rounded, obtuse, or acute, glabrous
Stipule: 2-7 mm long, all distinct
Stems: few to several, erect or ascending, forming clumps
Blooms:
Lookalikes: *A. p.* var. *laxiflorus* and *A. p.* var. *preussii* have vivid purple flowers and more, narrower leaflets, and the pods dry brownish
Habitat: warm **desert shrub** communities on sandy, seleniferous soils with level to moderate slopes, on the Shinarump and Chinle Formations. Known from 3,800 ft elevation.

VERY UNLIKELY TO BE SEEN

***Echinocereus triglochidiatus* var. *arizonicus* – Arizona hedgehog cactus**
Family: Cactaceae
Synonyms: *E. arizonicus var. arizonicus, E. coccineus var. arizonicus, Cereus polycanthus, Echinocereus polycanthus*
Status: Federal, LE; NN, none

Distinguishing characteristics
Plant caespitose, few branches or stems grow in clumps. As with all *Echinocereus* flowers burst through sides of stem, leaving scar on stem right above spine.
Stems: 22.5-40 cm long, 7.5-10 cm in diameter; dark green and cylindroid, usu. in clusters of 4-20 stems, occasionally exceeding 50.
Central Spines: 1-3, 2.5-40 cm long, grey or pinkish, the largest deflexed
Radial spines: 5-11, appresed, 0.5-1 cm long, light yellow or pinkish tab, often slightly curved.
Stem ribs: +/- 7 cm long, 10 tuberculate ribs, ribbing strong
Areoles: (of mature parts of stems) white felt or cobwebby hairs; nearly circular
Flowers: stay open for 2-3 days, even at night; +/- 5 cm in diameter and +/- 7 cm long; red to crimson (as with all *E. t.*) with yellow anthers, green stigma; style 2mm in diameter
Fruit: Red, fleshy at maturity
Blooms / fruits: April to May/ May to June; germinates mid-summer
Other varieties: As opposed to other varieties, *E.t.* var. *arizonicus* has flowers on upper third of stem ribs. Spines are shorter and more robust than other *Echinocereus*. *E.t.* var. *melanacanthus* has much smaller stems (in height and width), each cluster has many (up to 500) stems. *E.t.* var. *neomexicanus* has weaker ribbing, thinner central spines (0.5-1mm); central spines are not deflexed, smooth and are 4.5-7 cm long.
Habitat: open slopes of rugged steep-walled canyons, granite boulder-pile ridges and slopes in AZ desert grassland; shrubby vegetation, understory of shrubs, does not do well without extensive rock cover; 3,400-6,360 ft
Substrate: Normally found on Orthoclase-rich granite of late Cretaceous age; other parent materials in the area include volcanic tuff, mid-Tertiary age dacite and perhaps rhyolite.
Plant community: **interior Chaparral and Madrean Evergreen Woodland**; also into desert grassland. Often with the following associated species: *Quercus turbinella, Q. emoryi, Arcostaphylos pungens, Cercocarpus montanus, Nolina microcarpa, Dasylirion wheeleri, Agave chrysantha, Muhlenbergia emersleyi, Pinus monophylla, Juniperus erythrocarpa,* and *Rhus trilobata.*

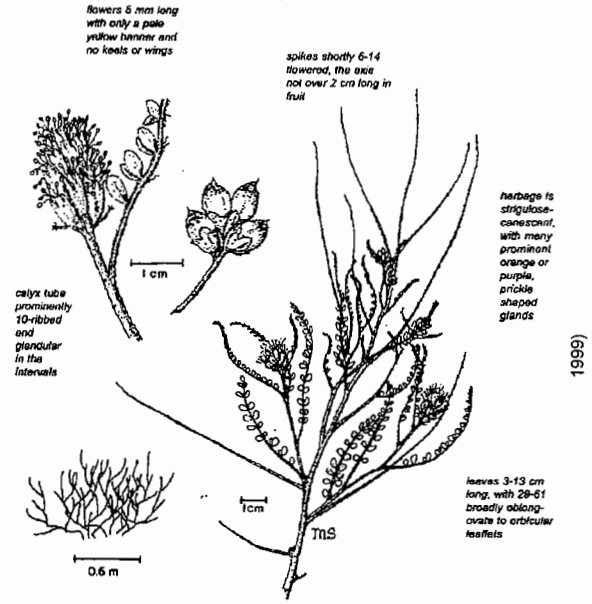
See next page for illustration



Cactaceae (Cactus Family)

VERY UNLIKELY TO BE SEEN

***Errazurizia rotundata* – Round dune-broom**
Family: Fabaceae
Synonym: *Paryella rotundata*
Status: Federal, none; NN, G4; State (AZ), SR



Fabaceae (Pea Family)

Distinguishing characteristics
Low, clonal, woody shrub, up to 30 cm tall
Flowers: 5 mm long with only a pale yellow banner and no keels or wings
Spikes: shortly 6-14 flowered, the axis not over 2 cm long in fruit
Herbage: strigulose-canescent, many prominent orange or purple, prickle shaped glands
Leaves: 3-13 cm long, with 29-61 broadly oblong-ovate to orbicular leaflets
Calyx: 5-6 mm long, turbinate, campanulate, tube prominently 10-ribbed and glandular in the intervals
Blooms: late April to early May
Habitat: Little Colorado River drainage, exposed sites in several types of outcrops ranging from sandy soils in sandstone, gravelly soils in calcareous outcrops, to deep, alluvial cinders in sandstone breaks; **desertscrub**, 4,800-5,200 ft.

VERY UNLIKELY TO BE SEEN

***Lesquerella navajoensis* O' Kane – Navajo Bladderpod**
Family: Brassicaceae
Synonyms: none
Status: Federal, none, NN, G4

Distinguishing characteristics
Perennial, cushion forming from a thick taproot
Flowers / Fruits: May to June

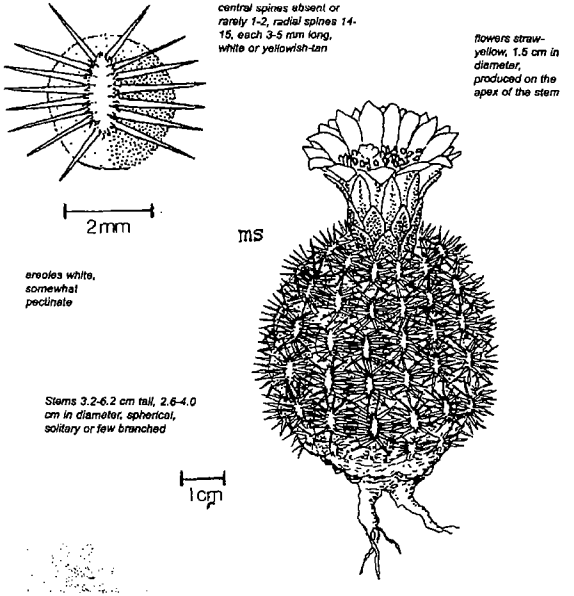
Lookalikes: *L. fendleri* has a deep orange "eye", the veins of the petals near the eye are also orange, the petals much larger and the stellate trichomes are webbed for at least half the length of the rays, *L. navajoensis* has a faint orange eye and no orange veins, the flowers are much smaller and the trichomes are not webbed.

Habitat: limited to windward, windswept mesa rims and nearby habitat with little vegetative cover (**pinyon-juniper**) and high insolation. Typically only found on the nearly white Todlito limestone member of the Morrison foundation which forms local mesa rims capping the Entrada Sandstone formation. Elevations range from 7200-7600 ft

VERY UNLIKELY TO BE SEEN

***Pedicactus bradyi* – Brady pincushion cactus**
Family: Cactaceae
Synonym: *Toumeya bradyi*
Status: Federal, LE; NN, G2

Distinguishing characteristics
The genus *Pediocactus* have no ribs, cylindric to globose stems, flowers <25mm in diameter, petals white or with pink or yellow at least on the midribs; fruit, dry, green, to tan/yellow, naked or scaly. *P. bradyi* is defined by unique capsule dehiscence, it is an endemic to Marble Canyon
Small, semi-globose, ranging from 2.5 to 5 cm in diameter
Central spines: absent or rarely 1-2
Radial spines: 14-15, each 3-5 mm long, white, yellowish-tan
Areoles: white, somewhat pectinate; vertical elongate
Stems: 3.2-6.2 cm tall, 2.6-4 cm in diameter, spherical, solitary or few-branched
Flowers: straw yellow, 1.5 cm in diameter, produced on the apex of the stem
Blooms: March to april, retracts into the soil in response to drought
Lookalikes: similar to juveniles of *Corypantha vivpara* but radial spines shorter
Habitat: Kaibab limestone chips overlaying soils derived from Moenkopi formation, 3,340-5,200 ft (very specific soil requirements). **Only grows in Marble Canyon**



Cactaceae (Cactus Family)