Appendix L

Plant Communities and Wildlife for the Major Ecosystems of the Rio Puerco

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Appendix L. Plant Communities and Wildlife for the Major Ecosystems of the Rio Puerco

L.1 THE SAGEBRUSH/GRASS ECOSYSTEM

The sagebrush/grass ecosystem or sagebrush steppe comprises roughly 20 percent or 164 square miles of the upper Rio Puerco watershed. It is found mainly in the upland valleys with piñon-juniper woodlands on the ridges, mesas, and mesa side slopes closely associated with it. This area may be the farthest south and east population of the big sagebrush/grass ecotype in the United States.

Geographically, this area extends north and south from the continental divide west of Cuba, New Mexico, south approximately 31 miles (near the village of San Luis, New Mexico). It ranges from the western foot of the Nacimiento Mountains on the east westward to near Torreon, New Mexico. This area is described broadly as the southeast portion of the Colorado Plateau.

This ecosystem can be further classified vegetatively as the shrubland formation, the Artemisia subformation, and the tridentata series.

Francis (1986) classified nine communities in the area:

- *Artemisia tridentata/Bouteloua gracilis-Hilaria jamesii*
- *Artemisia tridentata-Gutierrezia sarothrae/Bouteloua gracilis-Hilaria jamesii*
- *Artemisia tridentata/Bouteloua gracilis-Hilaria jamesii-Sporobolus airoides*
- *Artemisia tridentata-Gutierrezia sarothrae/Hilaria jamesii-Sporobolus airoides,*
- *Artemisia tridentata-Gutierrezia sarothrae/Bouteloua gracilis-Agropyron smithii*
- *Artemisia tridentata/Sporobolus cryptandrus-Oryzopsis hymenoides*
- *Artemisia tridentata-Chrysothamnus parryi/Aristida fendleriana-Bouteloua gracilis*
- *Artemisia arbuscula nova-A. tridentata/Agropyron cristatum-A. smithii*
- *Artemisia arbuscula nova-Gutierrezia sarothrae/Bouteloua gracilis-Hilaria jamesii*

The sagebrush/grass ecosystem occurs on 11 ecological sites that include: WP-1 Clayey, WP-1 Clayey Upland, WP-1 Salty Bottomland, WP-1 Swale, WP-1 Loamy Upland, WP-1 Loamy, WP-1 Deep Sandy Upland, WP-1 Sand Plains, WP-1 Sandy, WP-1 Shallow Upland, and WP-1 Gravelly Slopes.

L.1.1 Soils

The sagebrush/grass ecosystem occurs on the following soils from the Sandoval County Soil Survey and the Cabezon Soil Survey:

Alluvial land
Billings silty clay loam, alkali and gullied land
Fronton-Travessilla-Persayo assoc.
Las Lucas loam
Penistija fine sandy loam
Penistija-Sandstone outcrop assoc.
Prewitt loam and gullied land
Sparham clay
Orlie-Sparham assoc.
Pinitos loam
Vessilla-Menefee-Orlie assoc.
Berent loamy fine sand
Billings and Persayo silty clay loams
Fruitland sandy loam
Las Lucas-Persayo assoc.
Penistija-Berent assoc.
Persayo-Shale outcrop assoc.
Ravola silty clay loam and gullied land
Orlie-Sparham clay
Orlie loam
Blancot-Councelor-Tsosie assoc.

L.1.2 Vegetation

The U.S. Forest Service found the following mean annual production in the nine plant communities:

Table L-1: Mean Annual Plant Production by Plant Community

Species	Pounds/Acre
Western wheatgrass	20.1
Blue grama	50.4
Galleta grass	23.2
Alkali sacaton	20.8
Bottlebrush squirreltail	8.8
Broom snakeweed	31.4
Annuals	7.5
Other species	98.8
Total (not including sagebrush)	**263.1**

The BLM measured a mean annual production for big sagebrush in the upper Rio Puerco watershed to be 32 pounds per acre (air dry). If 32 is added to the total mean above for mainly understory grasses and forbs, then the total herbaceous and sagebrush production would be 295.1 pounds/acre/year.

The most important vegetative attribute for watershed stabilization is cover. A study of several relict areas in different states showed the following:

Table L-2: Vegetative Cover by State

State	Cover	
	Grass	Sagebrush
Idaho	60%	20%
Northern Utah	-	9-39%
Southeast Oregon	75%	25%
Nevada	78%	13%

The US Forest Service Range Experimental Station measured a mean of 62.2 percent grass cover, 30 percent sagebrush cover for a 67/32 grass/shrub ratio, 18.8 percent total plant cover, 11.3 percent letter, 0.1 percent rock, and 30.25 percent total cover for the Upper Rio Puerco.

The RPFO multidisciplinary team decided that the desirable sagebrush cover should be somewhere between 16 to 22 percent. If an area exceeds this, best management practices will be applied to bring it up to standards.

Valley bottoms in this ecotype should have big sagebrush removed completely, where possible. This is especially true where no defined channel has been cut and the area may support a grassland.

Four seral communities or condition classes can be described for the sagebrush/grass ecosystem in the upper Rio Puerco watershed, low seral, mid seral, high seral, and the potential plant community.

L.1.1.1 Low Seral

This community includes big sagebrush with a good understory of perennial grasses and forbs. It should have a shrub cover of 10-30 percent. Several species of shrubs may be present, including big sagebrush, winterfat, fourwing saltbush, shadscale, rabbitbrush, horsebrush, black greasewood, and plains prickly pear. Soils and watershed conditions should remain unchanged or stable. Wildlife habitat is relatively good for most species, with a high biodiversity. This community provides good stream bank vegetation adjacent to riparian areas. It also provides good diversity and quality of wildlife habitat. Vegetation and litter provide high infiltration with a relatively low runoff potential and erosion potential. In general, the community provides the potential for

prescribed fire. Plant cover is as follows: herbaceous cover of 63-74 percent, sagebrush cover of 10-25 percent, litter of 16-20 percent, and rock of 0.1-0.5 percent. **Table L-3** shows the production by species:

Table L-3: Low Seral Production by Species

Species	Pounds/Acre Air Dry
Western wheatgrass	40-55
Alkali sacaton	20-150
Galleta grass	40-65
Bottlebrush squirreltail	20-25
Blue grama	18-50
Broom snakeweed	10-15
Annuals	2-5
Big sagebrush	10-18
Other species*	300-400

L.1.1.2 Mid Seral

In this community, big sagebrush is present with a sparse understory of perennial grasses and forbs. The shrub cover is 20-40 percent, mostly consisting of big sagebrush. Few soil erosion problems exist on level to nearly level sites; however, erosion may be severe on steeper sites. Wildlife habitat quality has been reduced for most species, but may provide good habitat for some species. When adjacent to riparian habitat, this community may cause increased sediment loads in stream channels. The quality of livestock forage may be reduced from a loss of perennial grasses and forbs. There is a lower diversity of herbaceous plant cover. Infiltration is moderate to low, but varies with soil type and litter cover. Runoff potential is moderate to high and erosion may be severe on steeply sloped sites or unchanged on nearly level sites. The potential for prescribed fire is fair. Plant cover is as follows: herbaceous cover 36-62 percent, sagebrush cover 26-30 percent, litter 9-15 percent, rock 0 percent. **Table L-4** shows the production by species:

Table L-4: Mid Seral Production by Species

Species	Pounds/Acre Air Dry
Western wheatgrass	5-15
Alkali sacaton	5-12
Galleta grass	20-33
Bottlebrush squirreltail	15-30
Blue grama	45-60
Broom snakeweed	25-35
Annuals	5-10
Big sagebrush	25-35
Other species*	49-150

L.1.1.3 High Seral

This community includes dense sagebrush with few perennial herbaceous plants. Many annual plants may occur depending on the amount of spring moisture. Abundant reproduction is apparent for the big sagebrush, with several age classes occurring. Shrub cover is 30-60 percent, and almost exclusively sagebrush. There may also be extensive areas of rabbitbrush. This stage provides poor habitat for most wildlife species; however, it may provide good winter range for pronghorn and mule deer. There is a high potential for erosion. Usually, there is an increased sediment load to streams and arroyos. As riparian vegetation is lost, water temperature increases, more bank cutting occurs, and velocity of flows increase. This stage provides a low quality of livestock forage with little herbaceous understory. There are high interception losses because of shrub density. Low infiltration exists between shrubs due to lack of herbaceous plants. Runoff potential is

high on sloped sites. Rills and flow patterns are evident, along with pedestaled plants. The potential for prescribed fire is low; such a fire will probably burn only under high temperatures and high wind conditions. Before prescribed fire can be used, the site may have to be treated with an herbicide first. Plant cover is as follows: herbaceous cover 10-35 percent, sagebrush cover 31-45 percent, litter 7-14 percent, rock 0.1-0.5 percent. **Table L-5** shows the production by species.

Table L-5: High Seral Production by Species

Species	Pounds/Acre Air
Western wheatgrass	0-5
Alkali sacaton	2-5
Galleta grass	3-13
Bottlebrush squirreltail	0-5
Blue grama	2-20
Broom snakeweed	36-47
Annuals	15-25
Big sagebrush	35-50
Other species*	25-35

L.1.1.4 Potential Plant Community

In this community, little or no herbaceous understory is present, with a dense cover of big sagebrush 30 years of age or older. Sagebrush cover is over 50 percent. Piñon and juniper trees have begun to invade the area at the upper elevations. There is low quality wildlife habitat for most species. This stage may provide seasonal forage for herbivores (mule deer and pronghorn) and seeds for granivores. This stage is often accompanied by loss of much of the riparian vegetation, associated with entrenched gullies or stream channels that have had a lowering of the water table. Sagebrush and rabbitbrush invade the riparian zones and replace riparian species, such as cottonwoods and willows. There will be poor water quality in streams, with high sediment loads occurring. The community will have low biodiversity with a low number of migrant birds. Livestock forage is of poor quality in monotypic sagebrush stands. Almost no perennial and annual herbaceous plants are present, with bare ground exposed in interspaces. There is a possibility of severe erosion, including high sheet and rill erosion of soil occurring on colluvial and alluvial slopes. Extensive soil capping is in evidence. There is poor infiltration with high runoff potential, except in coppice mounds of dead shrubs. This is a vegetative plant community that is highly resistant to fires. Brush control may have to be accompanied by seeding because there is no understory seed source. Plant cover is as follows: herbaceous cover 2-9 percent, sagebrush cover 46-75 percent, litter 4-6 percent, rock 0.1-0.5 percent. **Table L-6** shows production by species.

Table L-6: Potential Plant Community Production by Species

Species	Pounds/Acre Air Dry
Western wheatgrass	0-1
Alkali sacaton	0-1
Galleta grass	4-1
Bottlebrush squirreltail	2-3
Blue grama	2-3
Broom snakeweed	45-55
Annuals	25+
Big sagebrush	50+
Other species*	2-3

*The most important other_species, based upon cover, frequency, density, and importance value in the plant community are:

Buckwheats, asters	Crested wheatgrass	Fendler threeawn
Globe mallow	Goldenweeds	Indian ricegrass
Loco weeds	Mat muhly	Needle and thread grass
New Mexico feathergrass	Parrey rabbitbrush	Prickly pear, etc.
Prickly phlox	Red threeawn	Rubber rabbitbrush
Sand dropseed	Spike dropseed	Tumble grass

L.1.3 Wildlife

The following wildlife is associated with the sagebrush/grass ecosystem in the upper Rio Puerco area of New Mexico.

Mammals

Badger	Big brown bat	Coyote
Botta's pocket gopher	Brush mouse	Ground squirrel
Deer mouse	Elk	Little brown myotis
Gunnison's prairie dog	Kit fox	Plains pocket mouse
Mule deer	Pallid bat	Silky pocket mouse
Pronghorn	Rock squirrel	Western harvest mouse
Southern plains woodrat	Striped skunk	
White-footed deer	White-tailed antelope	
mouse	Bobcat	

Birds

American kestrel	White-crowned sparrow	Barn swallow
Bewick's wren	Ash throated flycatcher	Black-chinned hummingbird
Black-headed grosbeak	Black throated sparrow	Blue grosbeak
Blue-gray gnatcatcher	Black-throated gray warbler	Brewer's sparrow***
Broad-tailed	Brewer's blackbird	Burrowing owl
hummingbird	Brown-headed cowbird	Common poor-will
Chipping sparrow	Common night-hawk	Dark-eyed junco
Common raven	Cooper’s hawk	Green-tailed towhee
European starling	Golden eagle	House wren
Horned lark ***	House finch	Marsh hawk
Ladder-backed	Loggerhead shrike	Mourning dove
woodpecker	Mockingbird	Orange-crowned warbler
Merlin	Northern oriole	Red-breasted nuthatch
Northern flicker	Prairie falcon	Rock wren
Plain titmouse	American robin	Sage sparrow ***
Red-tailed hawk	Rufous-sided towhee	Scott's oriole
Rufous hummingbird	Say's phoebe	Vesper sparrow ***
Sage thrasher ***	Solitary vireo	Western wood-pewee
Sharp-shinned hawk	Western meadowlark	White-throated swift
Western bluebird	White-breasted nuthatch	

***obligates or facultative species that spend some or all their time in the ecotype

Lizards

Checkered whiptail	Eastern collared lizard	Great Plains skink
Lesser earless lizard	Little striped whiptail	Many-lined skink
New Mexico whiptail	Plateau whiptail	Greater short-horned lizard
Side-blotched lizard	Ornate tree lizard	

Snakes

Desert striped whipsnake
Western diamondback rattlesnake
Gopher (bull) snake

Amphibians

Plains spadefoot toad
Western spadefoot toad
Woodhouse's toad

L.1.4 Desired Plant Community

The desired plant community for the sagebrush/grass ecosystem in the upper Rio Puerco watershed in New Mexico should have the following elements:

- Range condition: Low seral, as previously described, with 16-25 percent big sagebrush cover. If cover of big sagebrush exceeds this range, then brush control should be scheduled.
- Mosaic pattern of sagebrush and herbaceous understory.
- High biodiversity of wildlife including the listed obligate and facultative species.

L.2 THE PIÑON AND JUNIPER ECOSYSTEM

Piñon-juniper woodlands cover approximately 18 percent of the upper Rio Puerco watershed. Approximately 14 percent of this total is considered "manageable" using criteria of density and quality. The remaining is juniper savanna more suitable for grazing management than woodland products.

Elevations range from 6,600 to 7,400 feet. Frost-free days range from 100 to 140 (mean 120 days). Annual precipitation for a normal year ranges from 10 to 16 inches (mean 13 in.). For a drought year it ranges from eight to 14 inches (mean 11 inches). Snowfall ranges from 25 to 40 inches falling from October through March.

There is a vegetative continuum in the upper Rio Puerco from lower to higher elevation and from south to north. This continuum goes generally from grasslands, to juniper savanna, to juniper dominated piñon-juniper, to piñon dominated piñon-juniper, to ponderosa pine forests.

Characteristics that differentiate grasslands from woodlands are: Woodland sites have 6 percent or more ground cover of stones or bedrock, slopes range from 9 to 15 percent, piñon pine is present, a mixture of rock and soil provides the suitable hydrologic environment for piñon-juniper woodland, and the most consistent indicator of an original piñon-juniper site is the stoniness or coarseness of the soil.

Woodland vegetation differs from forest vegetation in that the canopies of individual woodland trees rarely touch or overlap and are generally smaller in stature than forest tree species.

Peddie and Moir (1993) and Francis (1986) found the following characteristics of piñon-juniper woodlands in New Mexico for the woodland continuum:

L.2.1 Juniper-Savanna Woodland

- 130 trees/acre or less
- Tree cover 5-30 percent
- Height of the tallest trees were less than 16 feet
- Mean herbaceous understory production 187.2 pounds/acre, air dry

L.2.2 Piñon Pine-dominated woodland

- 170 trees/acre (mean)
- Tree cover 30-50 percent
- Height of tallest trees 13-26 feet
- Mean herbaceous understory production 108.9 pounds/acre air dry

L.2.3 Ponderosa Pine/Mesic (closed woodlands)

- 280 + or - 50 trees/acre
- Tree cover 50-80 percent
- Height of tallest trees excluding ponderosa pine 23-42 feet mean herbaceous understory production 143.8 pounds/acre air dry

L.2.4 Soils of the Woodlands

Soils are usually shallow and are derived from granite, basalt, limestone, and mixed alluvium. Topographically, they are found on mesa tops, mesa side slopes, ridges, foothills, and colluvial slopes. The following soil mapping units identified in the Cabezon soil survey and the Sandoval county soil survey are occupied by the piñon-juniper woodland ecosystem:

- Atarque-Menefee-Rock outcrop complex
- Berent sandstone outcrop association
- Councelor-Eslendo-Mespun complex
- Ildefonso very stony loam
- Montecito complex
- Persayo Gravelly Soils-Shale outcrop association
- Pinitos Loam
- Rock Outcrop-Travessilla-Persayo association
- Sandstone Outcrop-Travessilla association
- Travessilla-Persayo-Billings association
- Vesilla-Menefee-Rock outcrop complex
- Basalt Outcrop-Cabezon association
- Billings And Persayo Silty Clay Loam
- Hagerman-Bond association
- Litle-Persayo association
- Penistaja-Sandstone outcrop association
- Persayo-Shale outcrop association
- Rock Outcrop Saido complex
- Rock Outcrop-Zia complex
- Skyvillage-Sandoval-Rock outcrop complex
- Vesilla-Menefee-Orlie association
- Zia-Skyvillage-Rock outcrop complex

L.2.5 Woodland Characteristics

The piñon-juniper woodland or dwarf conifer ecosystem is characterized by one or more species of piñon pine and juniper. Throughout most of the ecosystem, junipers outnumber piñons.

The Colorado piñon (*Pinus edulis*) is the common denominator in most piñon-juniper stands. Piñons range between nine and 35 feet tall and five to 18 inches in diameter. In the average piñon-juniper stand in New Mexico, piñons account for 61 percent of the trees and are most common in the smaller size classes. The average stand contains 462 trees and 90 square feet of basal area per acre. Piñon saplings grow four to six inches in height annually. Mature piñon grow two to four inches in height annually. On better sites, piñon can grow to 12 inches in diameter within 150 years. The proportion of piñon in the stand increases with increased elevation and moisture until it becomes the primary species at about 7,200 feet. Seed crops occur every four to seven years depending upon the weather, site conditions, and insect herbivory. Trees start bearing cones at 25 years, but production peaks when trees are 75 to 100 years old. They can reach ages of over 400 years. Cones require three growing seasons to mature and contain about 20 seeds. A productive tree can produce about 20 pounds of seed, and an acre can yield about 300 pounds of seed. Mature seed release starts in mid-September and can continue for a 50-day period.

The three most common junipers associated with the piñon are one-seed (*Juniperus monosperma*), Rocky Mountain (*J. scopulorum*) and Utah juniper *(J. osteosperma*). Alligator juniper (*J. deppeana*) is common further south in Cibola County, both east and west of El Malpais.

Junipers are multi-stemmed trees less than 40 feet in height. Junipers are generally more drought tolerant than piñons, and tend to predominate on drier sites. Junipers generally grow slower than piñon. They grow four inches in height annually up to age 40, 1.3 inches from 40 to 80 and 0.7 inches from 80 to 300. Annual diameter growth (for Rocky Mountain juniper) is about 0.08 inches up to 170 years of age and 0.03 inches afterward. In the average piñon-juniper stand in New Mexico, junipers makeup slightly more than half of the basal area and 47 percent of the stand cubic feet volume.

One-seeded juniper taproots of mature trees are 18 inches to 12 feet in length. Lateral roots are 2.5 to 3 times as long as the tree is tall, usually in the surface three feet of the soil and roost concentrated in the surface six inches.

A 1975 range inventory of the upper Rio Puerco watershed showed the following species composition in piñon-juniper woodland sites:

Table L-7: Species Composition of Piñon-juniper Sites of the Upper Rio Puerco Watershed, 1975

Species	Percent Composition
All juniper species	27
Piñon pine	23
Blue grama	14
Big sagebrush	9
Galleta grass	6
Broom snakeweed	5
All oak species	3
Ponderosa pine	1
Black grama	1
Prickly pear	1
Fringed sage and Bigelow sage	1
Mountain mahogany	1
Threeawn species	1

Species	Percent Composition
Sand dropseed	1
Bottlebrush squirreltail	1
Prairie junegrass	1
Sideoats grama	1
Western wheatgrass	1
Needle and thread grass and New Mexico feathergrass	1

The 1975 survey also found the following (mean) percent cover:

Table L-8: Mean Percent Cover within Piñon-juniper Sites, Upper Rio Puerco, 1975

Cover	Percent
Forage vegetation	12.7
Total vegetation	30.3
Litter	20.9
Gravel	9.2
Cobble/stone	6.7
Bare ground	32.5

Francis (1986) found the following woodland communities:

Juniper Savanna

Major understory species based upon importance value ranking:

Blue grama
Galleta grass
Broom snakeweed
Sand dropseed

Percent Cover in Juniper Savanna

Cover	Percent
Total Plant	13.3
Tree (Juniper)	5.7
Shrub	.9
Herbaceous	6.7
Litter	7.9
Rock	11.4
Bare Soil	74.0

Juniper-dominated Woodland

Major understory species based upon importance value ranking:

Blue grama
Galleta grass
Broom snakeweed
Sand dropseed
Big sagebrush
New Mexico feathergrass
Red threeawn
Baby white aster
Black grama
Bottlebrush squirreltail
Sideoats grama
Western wheatgrass

Percent Cover in Juniper-dominated Woodland

Cover	Percent
Total plant	15.9
Tree	3.4
Shrub	5.1
Herbaceous	7.4
Litter	16.1
Rock	10.0
Bare Soil	66.4

Piñon Dominated Woodland

Major understory species based upon importance value ranking:

- Blue grama
- Galleta grass
- Buckwheat species
- Hairy gold aster
- James eriogonmum
- Plains pricklypear
- Broom snakeweed
- Sedge species
- Gambel's oak
- Baby white aster
- Sand dropseed
- Ephedra species
- Greene's rabbitbrush
- Indian ricegrass
- Hymenoxys species

Percent Cover in Piñon Dominated Woodland

Cover	Percent
Total plant	11.9
Tree	4.7
Shrub	2.7
Herbaceous	4.5
Litter	6.5
Rock	8.3
Bare Soil	80.8

Common Woodland Products:

- Fuelwood - The piñon-juniper ecosystem provides heating and cooking fuel for thousands of households in the area. The present and future demand for piñon pine and juniper fuel wood will probably remain high because there is no suitable alternative.
- Fence Posts - The "cedar" (juniper) post fenced the west and will continue to be used for line posts and brace posts.
- Christmas Trees - The popularity of cutting your own Christmas tree is growing and BLM has provided suitable areas, especially in old tree chainings where young (20 year old) trees have re-invaded the sites. Pruning piñon pine will improve a stand if the objective is for Christmas tree production.
- Nuts - Piñon nuts have been a staple food for Native Americans from time immemorial and a delicacy for others. They are nutritious and delicious and their growing popularity has created a high demand for this crop.
- Ornamental Wildlings - The piñon pine is widely used for landscaping and this use is increasing in the Albuquerque metropolitan area.

L.2.6 Wildlife

The following lists of mammals, birds, lizards, snakes, and amphibians are common to the piñon-juniper woodlands in the Rio Puerco watershed. Other uncommon, largely migratory species, found occasionally in this ecosystem are not listed.

Woodland mammals

- Little brown myotis
- Long-eared myotis
- Big brown bat
- Hoary bat
- Woodland cottontail rabbit
- Colorado chipmunk
- White-tailed antelope ground squirrel
- Rock squirrel
- Botta's pocket gopher
- Silky pocket mouse
- Western harvest mouse
- Deer mouse
- Piñon mouse
- White-footed deer mouse
- White-throated woodrat
- Southern plains woodrat
- Stephen's woodrat
- House mouse
- Porcupine
- Coyote
- Gray fox
- Badger
- Striped skunk
- Mountain lion
- Bobcat
- Mule deer
- Elk

Woodland Birds

- Sharp-shinned hawk
- Cooper's hawk
- Red-tailed hawk
- Golden eagle
- Prairie falcon
- Merlin
- Great horned owl
- Wild turkey
- Common poor-will
- Common nighthawk
- White-throated swift
- Black-chinned hummingbird
- Broad-tailed hummingbird
- Northern flicker
- Acorn woodpecker
- Ladder-backed woodpecker
- Cassin's kingbird
- Ash-throated flycatcher
- Hammond's flycatcher
- Western wood-pewee
- Barn swallow
- Cliff swallow
- Steller's jay
- Piñon jay
- Common raven
- Plain titmouse
- Lead-colored bushtit
- Bewick's wren
- American robin
- Blue-gray gnatcatcher
- Solitary vireo
- Orange-crowned warbler
- Black-throated gray warbler
- Scott's oriole
- Black-headed grosbeak
- House finch
- Green-tailed towhee
- Rufous-sided towhee
- Brown towhee
- Rufous-crowned sparrow
- Dark-eyed junco
- Chipping sparrow
- White-crowned sparrow
- Townsend's solitaire

* Obligate woodland species

Piñon jays and scrub jays disperse piñon seeds.

Townsend's solitaire, cottontail, coyote and mice disperse juniper seeds.

Woodland Lizards

- Collared lizard
- Eastern fence lizard
- Short-horned lizard
- Ornate tree lizard
- Side-blotched lizard
- Little striped whiptail
- Plateau whiptail
- Checkered whiptail
- Great Plains skink
- Many-lined skink

Snakes

- Night snake
- Desert-striped whipsnake
- Gopher (bull) snake
- Western (prairie) rattlesnake
- Western diamondback rattlesnake

Amphibians

- Red spotted toad
- Woodhouse's toad

For browsing wildlife, the winter forage from woody plants is the major value of the piñon-juniper woodland ecosystem. Dietary studies in New Mexico woodlands show the following in descending order of utilization:

- Mountain mahogany
- Gray oak
- Birdsbill day flower
- Morning glory
- Spiderwort
- Deer vetch

Woodland management in the Rio Puerco watershed should take into account certain damaging agents:

Piñon Pine

- Piñon sawfly (*Neodiprion edulicolus*)
- Piñon tip moth (*Dioryctria albovittella*)
- Piñon needle scale (*Matsucoccus acalyptus*)
- Cone moth (*Eucasma bobana*)
- Piñon Ips (*Ips confusus*)
- Piñon dwarf mistletoe (*Arceuthobium divaricatum*)

Woodpeckers and porcupines also cause considerable damage to piñon pine.

Junipers

- Twig beetles (*Phloeosinios spp.*)
- Twig girdlers (*Stylox app.*)
- Rusts (*Gymnosporangium spp.*)
- True mistletoes (*Phoradendron spp.*)

L.2.7 Desired Plant Communities

Piñon Dominated Woodland

Percent Cover in Piñon Dominated Woodland

Cover	Percent Composition (by weight)
Trees	65
Piñon pine	43
Juniper species	22
Shrubs	14

~~*[Note to BLM: Please clarify the information on this page and the following page. What do the numbers mean? Should they be in tables? Please provide names for tables.]*~~

Big sagebrush		Mountain mahogany
Yucca		Skunkbush sumac
Prickly pear cactus		Bitterbrush
Fringed sage		Winterfat
Wavy leaf oak		Apache plume
Grasses or Grasslikes	30	
Blue grama		Needle & thread
Galleta		Western wheatgrass
Indian ricegrass		Mutton bluegrass
Littleseed ricegrass		Dryland sedge
Bottlebrush squirreltail		Prairie junegrass
Forbs	5	
Groundsel		Salsify
Indian paintbrush		Hymenoxys sp.
Buckwheat		Deer vetch
Multiflower gilia		Wright's silktassel
Penstemon sp.		Herbaceous sages
Sego lily		Spiderwort
Fleabane sp.		Bird's bill/dayflower
Four o'clock		

Cover	Percent
Total plant	11.9
Tree	4.7
Shrub	2.7
Herbaceous	4.5
Litter	6.5
Rock	8.3
Bare soil	73.3 or less

Juniper Dominated Woodland	Percent Composition by Weight
Trees	65

Juniper Dominated Woodland	Percent Composition by Weight
One-seed juniper	43
Piñon pine	22
Shrubs	14

Bigelow sage	Shrub live oak
Fringed sage	Gray oak
Cliffrose	Winterfat
Skunkbush sumac	Fourwing saltbush
Mountain mahogany	

Grasses	30

Blue grama	Sideoats grama
Galleta	Hairy grama
Alkali sacaton	Black grama
New Mexico feathergrass	Wolftail
Indian ricegrass	Thurber muhly

Forbs	5

Wormwood	Buckwheat species
Sego lily	Salsify
Globemallow	Indian paintbrush
Fleabane species	Hymenoxys species
Groundsel species	Gilia species
Four-o'clock	Penstemon species

Cover	Percent
Total Plant	15.1
Tree	4.2
Shrub	3.7
Herbaceous	7.2
Litter	13.4
Rock	10.5
Bare Soil	69.0

The percent species composition for trees, shrubs, grasses, and forbs are meant to be a mean on either side of which there is an acceptable range of 5-10 percent variation. The same holds true for the percent cover figures.

L.2.8 Treatment Recommendations

Wildlife

General guidelines for treatments designed to improve wildlife habitat include:

1. Minimum cover for wildlife in the piñon-juniper woodland ecosystem should be at least 50 acres in size and not less than 600 feet wide.

2. Provide travel or escape routes for movement of animals between the various islands and fingers of unmolested habitat cover.

3. Facilitate distribution of wildlife use through arrangement of openings and cover in relation to water and available forage supplies. Established routes of game travel (where known or suspected) should be given special consideration in laying out corridors.

4. Provide thermal cover (shelter) as an aid to the maintenance of constant body temperature by maintaining an adequate quantity of large trees of all species that provide both aerial cover and ground litter.

5. Old piñon pines with large boles (trunks) should not be removed unless more than 10 per acre are present. Larger snags should be retained as potential turkey roost trees, raptor nest sites, and other trees important to wildlife.

6. When clearing piñon-juniper stands, up to 10 large piñon trees per acre may be retained

7. All stringers and groves of ponderosa pine interspersed with woodland should be retained, including snags and any understory cover of ponderosa pine reproduction, unless they are diseased or infected with some damaging agent.

8. Treatment patterns or boundaries should be undulating to create optimum "edge" and uneven margins.

9. Water developments should be included in or adjacent to cover areas whenever possible.

10. Treatments should occur 100 to 200 feet away from rimrock areas.

Silviculture

The Rocky Mountain Forest and Range Experiment Station recommends the following silviculture methods for improving piñon-juniper woodlands that have a high site productivity for growing wood products. High site woodlands can produce wood products on a sustainable yield basis. These usually are found in the piñon dominated woodlands. The main goal is to obtain satisfactory tree regeneration for the future.

1. The two-step shelterwood method appears to work best for even age stand management. The even-aged system produces stands in which all trees are about the same age; that is, the difference in age between trees forming the main crown canopy level will usually not exceed 20 percent of the rotation length. The shelterwood cutting method is any regeneration cutting in a more or less mature stand, designed to establish a new crop under the protection of the old. The resultant crop will be even-aged. The shelterwood cutting method is characterized by a series of cuts called the preparatory cut, seed cut, and removal cut.

2. The single-tree selection method works best of the uneven-aged methods.

3. The uneven-aged system involves manipulation of a forest to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. The single-tree selection cutting involves removal of selected trees from specified size or age classes over the entire stand area in order to meet a predetermined goal of size or age distribution and species composition in the remaining stand.

4. Thinning for herbaceous improvement should not remove more than 65 percent of net crown cover.

5. Leave the best trees with largest crowns on a spacing of 20 x 20 feet to 30 x 30 feet.

6. Limit opening size to four to ten acres.

7. Lop and scatter is the preferred method of slash disposal outside of the WUI.

Slash Disposal

The following recommendations are specifically for slash disposal following a silviculture thinning method:

1. Lop and scatter of slash may reduce erosion, provide micro-climate conditions conducive to establishing an herbaceous understory, and prepare the fuel bed for broadcast burning.

2. For pile burning of slash, piles should not be placed under trees to be retained and pile size should be regulated in relation to predicated heat intensity with a general standard of less than 125 cubic feet per pile.

3. For chipping of slash, chip depth should not exceed two inches, with no one area deeper than six inches. For mastication of slash, mulched material should be less than three inches deep on average.

Watershed Stabilization

Because the piñon-juniper woodlands will be managed under silviculture methods, large-scale tree chainings, tree crushing, cabling, and dozer pushing will not be considered for best management practices.

Emphasis will be placed on water control projects in smaller gully systems and the use of slash windrows on side slopes and gullies. Roads that are not needed will be abandoned and reclaimed.

Visual Resource Management

Tree thinning in the piñon-juniper woodlands will give them a more open, park-like appearance and be more pleasing to the eye.

L.3 THE GRASSLAND ECOSYSTEM

L.3.1 Introduction

Grasslands make up approximately 38 percent of the upper Rio Puerco watershed in New Mexico. Much of this grassland has been invaded by broom snakeweed. It is dominant in approximately 17 percent of the grasslands. Approximately 11 percent of the grasslands were pitted or ripped during the 1950s.

Francis (1986) classified the area into grasslands, shrublands, and treeland. He also divided the area into five landform classes. This document will discuss the following six subformations within the grassland ecosystem:

1. Colluvial grasslands dominated by grama grasses and galleta grass (*Bouteloua and Pleuraphis*.)

2. Colluvial grasslands dominated by winterfat (*Krascheninnikovia*).

3. Lower colluvial and alluvial grasslands dominated by rabbitbrush-species. (*Chrysothamnus*)

4. Lower colluvial and alluvial grasslands dominated by saltbush species (Atriplex).

5. Alluvial grasslands dominated by dropseeds (*Sporobolus*).

6. Alluvial grasslands dominated by greasewood (*Sarcobatus*).

L.3.2 Soils

The following grassland soil-mapping units were recorded from the Cabezon and Sandoval County Soil Surveys:

- Basalt outcrop-Cabezon assoc.
- Billings silty clay loam, alkali, and gullied land
- Doak-Betonnie fine sandy loamy
- Ildefonso very stony loam
- Litle silty clay
- Penistaja-Bond assoc.

Persayo gravelly soils--Shale outcrop assoc.
Pinavetes-Galisteo, moderately saline, sodic assoc.
Ravola silty clay loam, alkali, and gullied land
Shavano-Berent assoc.
Sparank silty clay loam
Travissilla-Persayo-Billings assoc.
Billings and Persayo silty clay loamy
Cabezon-Basalt outcrop assoc.
Hagerman-Bond assoc.
Las Lucas soils
Litle-Las Lucas-Persayo
Penistaja-Hagerman assoc.
Pinavetes loamy sand
Querencia-Zia complex
Sandoval fine sandy loam
Sparank clay loam, moderately saline, sodic
Torreon loam

Greasewood dominated grassland soils:

- Christianburg clay and gullied land
- Navajo clay and gullied land
- Fruitland-Slickspot assoc.

Saltbush dominated grassland soils:

- Alkali alluvial land
- San Mateo loam

Winterfat Dominated grassland soils:

- Quarencia loam

Rabbitbrush dominated grassland soils:

- Billings silty clay loam and gullied land
- Little-Persayo assoc.

Snakeweed dominated grassland soils:

- Rock outcrop-Travessilla-Persayo assoc.

L.3.3 Species Composition and Cover

The following species composition and cover was observed in a 1975 forage inventory of the upper Rio Puerco watershed:

Table L-9: Species Composition of the Upper Rio Puerco Watershed

Major Species	Percent Species Composition
Broom snakeweed	23
Blue grama	20
Galleta grass	19
Alkali sacaton	11
Ring muhly	4
Red threeawn	2
Bottlebrush squirreltail	2
Sand dropseed	2
Crested wheatgrass	2
Fourwing saltbush	2
Winterfat	2

Major Species	Percent Species Composition
Western wheatgrass	1
Indian ricegrass	1
Fringed sage	1
Shadscale	1
Rubber-rabbitbrush	1
Prickly pear	1
Cholla cactus	1
One-seed juniper	1

The remaining 3 percent was made up of black grama, sideoats grama, New México feather grass, big sagebrush, Louisiana wormwood, and piñon pine. Other species found in trace amounts (less than 1 percent) were: Sideoats grama, hairy grama, sandhill muhly, mountain muhly, mat muhly, spike dropseed, needle & thread grass, sleepy grass, salt grass, burro grass, vine mesquite, plains lovegrass, cheat grass, buckwheats, Parry rabbitbrush, Douglas rabbitbrush, broom dalea, Mormon tea, wolfberry, shrub liveoak, and black greasewood.

Table L-10: Alluvial Grasslands Dominated by Greasewood (1975)

Major Species	Percent Composition
Black greasewood	56
Alkali sacaton	18
Shadscale	7
Western wheat grass	3
Fourwing saltbush	3
Galleta grass	2
Broom snakeweed	2
Blue grama	1
Parry rabbitbrush	1
Obovate saltbush	1
Bottlebrush squirreltail	1
Russian thistle	1

Table L-11: Percent Cover Types in the Upper Rio Puerco Watershed

Cover (1975)	Percent
Total plant	26.9
Forage vegetation	18.3
Litter	19.6
Small rock (gravel)	3.9
Large rock (cobble/stone)	0.8
Bare soil	48.6
Average slope	3.2

The remaining 4 percent was red threeawn, mat muhly, ring mutely, pale wolfberry, and walking stick cholla.

589 **Table L-12: Alluvial Grasslands Dominated by Saltbush (1975)**

Major Species	Percent Composition
Fourwing saltbush	58
Alkali sacaton	15
Broom snakeweed	5
Blue grama	5
Galleta grass	5
Russian thistle	3
Sand dropseed	2
Black greasewood	1
Shadscale	1
Bottlebrush squirreltail	1
Western wheatgrass	1

590 The remaining 3 percent was mat muhly, crested wheatgrass, red threeawn, Indian ricegrass, spike dropseed,
591 New Mexico feathergrass, obovate saltbush, rubber rabbitbrush, Douglas rabbitbrush, winterfat, and walking
592 stick cholla.

593 The following cover, density, frequency, and composition rankings were compiled from the Phyto-Edaphic
594 Communities of the Upper Rio Puerco Watershed, New Mexico by Richard E. Francis (A 10 year research
595 study).

596 1. Colluvial grasslands dominated by grama grasses and galleta (Bouteloua and Hilaria). The following
597 species are ranked in order of their importance. The percent mean cover, density and frequency
598 are listed:

599 **Table L-13: Species in the Colluvial Grasslands of the Upper Rio Puerco Watershed**

Species	Cover	Density	Frequency
Blue grama	27.6	32.0	15.8
Galleta grass	23.9	31.3	22.6
Alkali sacaton	10.2	4.7	6.8
Sand dropseed	5.5	7.1	13.9
Broom snakeweed	9.6	2.3	9.0
Black grama	5.7	6.0	4.9
New Mexico feathergrass	1.2	1.6	1.8
Ring muhly	1.2	1.4	1.4
Western wheatgrass	0.2	1.3	0.5
Fourwing saltbush	1.1	0.1	0.5
Bottlebrush squirreltail	0.3	0.5	2.5
Cholla cactus	1.0	0.2	0.8

600

Table L-14: Percent Cover in the Colluvial Grasslands of the Upper Rio Puerco Watershed

Cover (mean)	Percent
Total plant	32.9
Tree	0.1
Shrub	2.0
Herbaceous	14.5
Litter	4.8
Rock	5.6
Bare soil	73.6

The following production was measured for colluvial grassland sites:

Table L-15: Production of Species in Colluvial Grasslands of the Upper Rio Puerco Watershed

Species	Pounds/Acre Air Dry
Western wheatgrass	9.9
Blue grama	93.8
Galleta grass	48.9
Alkali sacaton	50.9
Bottlebrush squirreltail	9.4
Annuals	10.5
Other species	127.1
Total	330.0

2. Colluvial grasslands dominated by winterfat (Ceratoides):

Table L-16: Colluvial Grasslands Dominated by Winterfat in the Upper Rio Puerco Watershed

Species	Pounds/Acre Air Dry
Western wheatgrass	0.5
Blue grama	45.4
Galleta grass.	61.6
Alkali sacaton	43.6
Bottlebrush squirreltail	17.0
Annuals	2.8
other species	79.0
Total	249.9

The BLM production studies showed a mean production of winterfat to be 15 pounds/acre for colluvial grasslands.

3. Lower colluvial and alluvial grasslands dominated by rabbitbrush species (chrysothamnus):

Table L-17: Species In Lower Colluvial and Alluvial Grasslands Dominated by Rabbitbrush Species in the Upper Rio Puerco Watershed

Species	Cover	Density	Frequency
Blue grama	58.3	58.3	36.2
Western wheatgrass	5.0	20.7	14.0
Galleta grass	7.2	9.3	10.0
Rabbitbrush species	17.6	0.2	3.7
Sand dropseed	1.8	4.0	13.0
Alkali sacaton	2.7	0.9	2.6
Mat muhly	2.2	2.7	4.8
Threeawn species	0.7	0.6	2.7

Table L-18: Percent Cover of Lower Colluvial and Alluvial Grasslands Dominated by Rabbitbrush Species in the Upper Rio Puerco Watershed

Cover (mean)	Percent
Total plant cover	38.1
Tree cover	0
Shrub cover	7.7
Herbaceous cover	30.5
Litter	17.0
Rock	0.03
Bare soil	56.0

The following production was measured for rabbitbrush-dominated grasslands:

Table L-19: Production of Rabbitbrush-dominated Grasslands in the Upper Rio Puerco Watershed

Species	Pounds/Acre Air Dry
Western wheatgrass	59.8
Blue grama	162.5
Galleta grass	27.1
Alkali sacaton	16.5
Bottlebrush squirreltail	7.7
Annuals	15.9
Other species	76.5
Total	366.0

BLM production studies showed a mean production of rabbitbrush species to be 20 pounds/acre.

4. Lower colluvial and alluvial grasslands dominated by saltbushes (Atriplex):

Table L-20: Species in Lower Colluvial and Alluvial Grasslands-dominated by Saltbushes in the Upper Rio Puerco Watershed

Species	Cover	Density	Frequency
Alkali sacaton	17.6	8.1	18.9
Galleta grass	8.0	21.2	9.9
Obovate saltbush	15.5	7.4	12.5
Fourwing saltbush	24.3	4.5	4.2
Broom snakeweed	9.2	3.3	9.9
Spike dropseed	2.6	4.8	7.9
Sand dropseed	1.0	6.2	6.8
Moundscale	4.7	1.9	1.8
Mockheather (Frankenia)	5.3	0.4	1.2
Saltgrass	0.1	3.3	2.8
Mesa dropseed	1.2	1.5	2.4
Winterfat	0.3	1.1	2.8
Fendler threeawn	0.8	1.9	1.5
Globe mallow	0.2	0.6	1.4
Small soapweed	1.0	0.3	0.7
Shadscale	0.4	0.1	0.5
Vine mesquite	0.1	0.5	0.2

Table L-21: Percent Cover of Lower Colluvial and Alluvial Grasslands-dominated by Saltbushes in the Upper Rio Puerco Watershed

Cover	Percent
Total plant cover	14.3
Tree cover	0
Shrub cover	9.6
Herbaceous cover	4.7
Litter	7.0
Rock	0.8
Bare soil	87.4

The following production was measured for grasslands dominated by saltbushes (Atriplex):

Table L-22: Production of Grasslands Dominated by Saltbushes in the Upper Rio Puerco Watershed

Species	Pounds/Acre Air Dry
Western wheat grass	2.1
Blue grama	13.1
Galleta grass	36.4
Alkali sacaton	133.3
Bottlebrush squirreltail	5.9
Annuals	29.4
other species	96.3
Total	316.5

629 BLM production studies showed a mean production of 60 pounds/acre for shadscale and 43 pounds/acre for
630 fourwing saltbush.

631 5. Alluvial grasslands dominated by alkali sacaton:

632 **Table L-23: Species in Alluvial Grasslands Dominated by Alkali Sacaton in the Upper Rio**
633 **Puerco Watershed**

Species	Cover	Density	Frequency
Alkali sacaton	65.0	47.6	43.2
Galleta grass	7.6	16.0	11.3
Blue grama	5.9	15.5	7.6
Broom snakeweed	6.0	3.0	7.4
Sand dropseed	2.9	3.3	8.0
Western wheatgrass	2.1	4.9	4.9
Mat muhly	1.4	3.1	1.6
Tumble grass	0.5	0.9	2.9

634 The following production was measured for alluvial grasslands dominated by alkali sacaton:

635 **Table L-24: Percent Cover of Alluvial Grasslands Dominated by Alkali Sacaton in the**
636 **Upper Rio Puerco Watershed**

Cover	Percent
Total Plant	20.2
Tree	0
Shrub	1.5
Herbaceous	18.7
Litter	5.7
Rock	0.5
Bare soil	75.1

637
638 **Table L-25: Production of Alluvial Grasslands Dominated by Alkali Sacaton in the Upper**
639 **Rio Puerco Watershed**

Species	Pounds/Acre Air Dry
Western wheatgrass	19.9
Blue grama	26.2
Galleta grass	108.9
Alkali sacaton	219.7
Bottlebrush squirreltail	9.6
Annuals	12.7
Other species	45.0
Total	441.8

6. Alluvial grasslands dominated by greasewood (Sarcobatus):

Table L-26: Species in Alluvial Grasslands Dominated by Greasewood in the Upper Rio Puerco Watershed

Species	Cover	Density	Frequency
Black greasewood	60.5	30.5	48.5
Shadscale	16.6	23.7	19.5
Bottlebrush squirreltail	13.5	17.3	18.0
Western wheatgrass	5.2	26.5	9.0
Rubber rabbitbrush	2.0	.2	2.0

Table L-27: Percent Cover of Alluvial Grasslands Dominated by Greasewood in the Upper Rio Puerco Watershed

Cover	Percent
Total plant cover	21.8
Tree cover	0
Shrub cover	18.8
Herbaceous cover	3.0
Litter	11.9
Rock	0
Bare soil	85.1

The following production was measured for alluvial grasslands dominated by greasewood:

Table L-28: Production of Alluvial Grasslands Dominated by Greasewood in the Upper Rio Puerco Watershed

Species	Pounds/Acre Air Dry
Western wheatgrass	153.1
Blue grams	20.1
Galleta grass	6.0
Alkali sacaton	50.5
Bottlebrush squirreltail	27.6
Annuals	13.1
Other species	49.5
Total	319.9

BLM found the following mean production for black greasewood: 57 pounds/acre.

The following MLRA based ecological sites were correlated to grassland areas in the upper Rio Puerco:

1. Colluvial grasslands dominated by Bouteloua and Hilaria:

WP-2 Shallow Hills
WP-2 Malpais Breaks
WP-2 Gravely Upland
WP-2 Shale Hills
WP-2 Shallow Sandstone
WP-2 Gyp Hills
WP-2 Deep Sand
WP-2 Sandy
WP-1 & WP-2 Loamy
WP-1 Gravely Slopes
WP-1 Clayey Upland
WP--1 Loamy Upland
WP-1 Deep Sandy Upland

2. Colluvial Grasslands dominated by winterfat:

WP-2 Loamy
WP-2 Limy

3. Lower colluvial and alluvial grasslands dominated by rabbitbrush:

WP-I Clayey Upland

4. Lower colluvial and alluvial grasslands dominated by saltbush:

WP-2 Salt Flats
WP-2 Bottomland
WP-2 Swale

5. Alluvial grasslands dominated by alkali sacaton:

WP-2 Salt. Flats
WP-2 Clayey Bottomland
WP-1 & WP-2 Swale

6. Alluvial grasslands dominated by greasewood:

WP-2 Salt Flats
WP-I Salty Bottomland

L.3.4 Common Grassland Wildlife

Mammals

- Desert shrew
- Little brown myotis
- Western pipistrelle
- Big brown bat
- Pallid bat
- Cottontail rabbit
- Black-tailed jackrabbit
- Gunnison's prairie dog
- Spotted ground squirrel
- Botta's pocket gopher
- Ord's kangaroo rat
- Banner-tailed kangaroo rat
- Silky pocket mouse
- Plains pocket mouse
- Western harvest mouse
- Deer mouse
- White-footed deer mouse
- Northern grasshopper mouse
- White-throated woodrat
- House mouse
- Coyote
- Badger
- Striped skunk
- Bobcat
- Pronghorn

Birds

- Sharp-shinned hawk
- Cooper's hawk
- Red-tailed hawk
- Golden eagle
- Burrowing owl
- Prairie falcon
- American kestrel
- Scaled quail
- Mountain plover
- Mourning dove
- Roadrunner
- Common nighthawk
- Northern flicker
- Western kingbird
- Say's phoebe
- Horned lark
- Tree swallow
- Common raven
- Rock wren
- Mockingbird
- American robin
- Loggerhead shrike
- European starling
- Western meadowlark
- Brewer's blackbird
- Brown-headed cowbird
- Northern oriole
- Blue grosbeak
- House finch
- Lark sparrow

Savannah sparrow	Cassin's sparrow	Lark sparrow
Vesper sparrow*	Black-throated sparrow	

Lizards

Lesser earless lizard	New Mexico whiptail
Eastern collared lizard	Little striped whiptail
Eastern fence lizard	Plateau whiptail
Greater short-horned lizard	Checkered whiptail
Ornate tree lizard	Great Plains skink
Side-blotched lizard	Many-lined skink

Snakes

Night snake
Desert striped whipsnake
Long-nosed snake
Western (prairie) rattlesnake
Western diamondback rattlesnake

Amphibians

Western spadefoot toad
Plains spadefoot toad
Red-spotted toad
Woodhouse's toad

*Obligate or facultative species

L.3.5 Desired Plant Communities

1. Colluvial grasslands dominated by Bouteloua, Hilaria, Ceratoides, and Chrysothamnus.

Ecological Condition	Pounds/Acre
Present (Low to mid-seral)	327
Grazing Management (High seral)	394
Treatment	632

Composition	Percent by Weight Range
Grasses or grasslike	55----73----85
Shrubs	10----19----35
Forbs	5-----8----10

Sandy sites--increase in spike dropseed, giant dropseed, Indian ricegrass, sand bluestem, and fourwing saltbush.

Rocky/Gravelly--increase in sideoats grama, little bluestem, hairy grama, wolf tail, black grama, cane bluestem, skunkbrush sumac, shrub live oak, Apache plume, wolfberry, New Mexico desert olive.

Limey--increase in New Mexico feather grass, mesa dropseed, Bigelow sage.

Gypsum soils--Mockheather, sand verbena, gyp dropseed, Townsend aster.

2. Alluvial grasslands dominated by alkali sacaton, greasewood, and saltbush.

Ecological Condition	Pounds/Acre
Present (Low to mid-seral)	388
Grazing Management (High seral)	700
Treatment	1,175

Composition	Percent by Weight Range
Grasses or grasslike	70----79----85
Shrubs	10----16----25
Forbs	5------6----10

Bottomlands/Salt Flats--increase vine mesquite, western wheatgrass, creeping muhly, mat muhly, and spike muhly.

As the alkalinity or salt content in the soil increases, there will be an increase in salt-grass, seepweed, arrow grass, iodine bush, greasewood, and saltcedar.

L.3.6 Wildlife

There should be an increase in nesting of migratory neotropical birds, raptors, and pronghorn and a decrease in the number of brown-headed cowbirds. A high seral vegetative diversity will improve the wildlife habitat overall.

Watershed Cover

Table L-29: Acceptable Range of Percent Cover for Colluvial Grasslands

Colluvial grasslands	Acceptable Range of Percent Cover
Total plant cover	18-28
Tree cover	0-0.3
Shrub cover	4-6
Herbaceous cover	11-18
Litter	8-10
Rock	2-3
Bare soil	68-72

Table L-30: Acceptable Range of Percent Cover for Alluvial Grasslands

Alluvial grasslands	Acceptable Range of Percent Cover
Total plant cover	18-20
Tree cover	0- 0
Shrub cover	4- 10
Herbaceous cover	8-16
Litter	6-8
Rock	0-0.4
Bare soil	73-83

Grasses and forbs halt erosion by the establishment of root systems that hold the soil in place. Quick sprouting varieties can cover the bare soil in a minimum of time. Forbs and grasses not only stop the erosion

of the land, but enrich the soil by adding nitrogen through their root systems. Living plants and plant residue (litter) provide ground cover on the surface of the soil, and intercept rainfall and other moisture. The ground cover slows the flow of water across the surface and increases the rate at which water soaks into the soil. Ground cover can be considered a practical manner of slowing or even eradicating erosion. Rainfall is most erosive when it is most intense. The upper Rio Puerco has a history of short-duration, high intensity storms. During these storms, grasses and forbs will increase the resistance to eroding water, thus improving the soil and water quality.

Visual Resources

Maintain an open, rolling grassland with as few visual disturbances as possible. Watchable wildlife for the visitor should include pronghorn and numerous raptors and songbirds.

L.4 THE PONDEROSA PINE ECOSYSTEM

L.4.1 Introduction

The ponderosa pine forests in the upper Rio Puerco are classified as lower montane coniferous forests. The series is Ponderosa Pine-Piñon Pine-Gambel Oak. Elevations range from 7,200 to 8,200 feet.

These forests are relatively warm and dry dominated by ponderosa pine (*Pinus ponderosa*). The climate is borderline for forests, and in the upper Rio Puerco would be considered the lower ponderosa pine forest representation. Warm air and soil temperatures allow a potential growing season of around 180 days. However, available water in upper portions of the soil profile is deficient during the hottest and driest months of May and June. The winters are cold, with mean precipitation of 20 inches/year and mean annual temperature of about 43 F. The soil temperature regime is frigid.

There are three subspecies of ponderosa pine. The subspecies native to the Rio Puerco is *Pinus ponderosa* ssp. *scopulorum*. On the highest northern aspects and near drainages, Douglas-fir (*Pseudotsuga menziesii*) and/or quaking aspen (*Populus tremuloides*) may occur, but both are uncommon.

Associated broadleaf trees and shrubs are Gambel and wavy-leafed oaks (*Quercus gambelii, Q. undulata*), wax currant (*Ribes cereum*), snowberry (*Symphoricarpus oreophilia*), wood rose (*Rosa woodsii*), New Mexico locust (*Robinia neomexicana*), rock spiraea (*Holodiscus dumosus*), and Colorado barberry (*Berberis fendleri*). Piñon pine (*Pinus edulis*) and Rocky mountain juniper (*Juniperus scopulorum*) are the two major evergreens associated with ponderosa pine.

Further south in Cibola County, Gray oak (*Quercus grisea*) and Alligator juniper (*Juniperus deppeana*) are more dominant.

Grasses found in the understory include Arizona fescue (*Festuca arizonica*), pine dropseed (*Blepharoneuron tricholepis*), little bluestem (*Schizachyrium scoparius*), mountain muhly (*Muhlenbergia montana*), fringed brome (*Bromus ciliatus*), and threadleaf sedge (*Carex filifolia*). In the transition zone between piñon-juniper woodland and ponderosa pine, mutton blue grass (*Poa fendleriana*) and prairie junegrass (*Koeleria cristata*) are more dominant.

Common forbs are Louisiana wormwood, fringed sagewort, buckwheat, spurge, Indian paintbrush, columbine, geranium, lupine, penstemon, deervetch, cinquefoil, groundsel, big golden pea, spiderwort, and salsify.

L.4.2 Ponderosa Pine Forest Soils

The Cabezon and Sandoval County soil surveys correlated four soil mapping units that are associated with ponderosa pine forests in the upper Rio Puerco.

1. Sedmar loamy sand in the Chijuilla-Cuba Mesa area
2. Basalt Outcrop-Orthents-Ustolls complex- I.C. Grant area
3. Orejas Rock outcrop complex- I.C. Grant area
4. Cabezon-Basalt outcrop association- I.C. Grant area

L.4.3 1975 Forage Inventory

The following cover data and species composition was recorded in the upper Rio Puerco area:

Table L-31: Coverage Type in the Upper Rio Puerco Area

		Percent
Forage	vegetation	14
Total	vegetation	35
Litter		33
Small	rock	4
Large	rock	7
Bare soil		21
Mean slope		11

Table L-32: Species Cover Type in the Upper Rio Puerco Area

Species	Percent
Ponderosa pine	35.5
Gambel's oak	17.5
Piñon pine	15.0
Blue grama	9.0
Juniper species	6.5
Prairie junegrass	3.0
Western wheatgrass	2.5
Mountain mahogany	1.5
Big sagebrush	1.5
Indian ricegrass	1.0
Buckwheat	1.0
Little bluestem	1.0
Mountain muhly	1.0
Pine dropseed	1.0
Threadleaf sedge	1.0
Dwarf rabbitbrush	1.0
Wax currant	1.0

Trace amounts of Arizona fescue, weeping brome, littleseed ricegrass, needle and thread grass, mutton bluegrass, side oats grama, big bluestem, rock spirea and snowberry were recorded.

L.4.4 USFS Research

Francis (1986) recorded data from two Ponderosa communities:

807 **Table L-33: Data from Ponderosa Community No. 1**

Community No. 1	Percent		
	Cover	Density	Frequency
Ponderosa pine	62.5	0.4	2.2
Threadleaf sedge	1.2	23.1	19.7
Pingue	3.0	19.3	24.6
Mutton bluegrass	.6	18.8	14.0
Blue grama	2.2	14.3	8.9
Piñon pine	14.9	0.4	1.0
Hairy grama	0.6	9.7	5.8
Gambel's oak	8.8	1.3	2.4

808
809 **Table L-34: Data from Ponderosa Community No. 2**

Community No. 2	Percent		
	Cover	Density	Frequency
Blue grama	5.8	51.2	18.9
Dwarf rabbitbrush	9.0	17.6	34.3
Piñon pine	33.1	0.0	0.0
Ponderosa pine	27.8	0.0	0.0
Threadleaf sedge	1.2	13.8	10.2
Baby white aster	0.3	4.4	7.5
Sand dropseed	1.2	2.8	6.4

810
811 Species found in lesser amounts included: one-seed juniper, Utah juniper, Yucca species, mountain mahogany,
812 rubber rabbitbrush, fringed sagewort, big sagebrush, Louisiana wormwood, James' buckwheat, pine
813 thermopsis, milkwort, pingue, junegrass, groundsel, red threeawn, evening primrose, rockcress, aster, pine
814 dropseed, mountain muhly, lupine, bottlebrush squirreltail, foxtail barley, globemallow, geranium, calyophus,
815 Arizona fescue, and pussytoes.

816 **L.4.5 Understory herbaceous production:**
817
818 **Table L-35: Production of the Understory Herbaceous Species**

Species	Pounds/Acre
Western wheatgrass	18.3
Blue grama	26.1
Galleta grass	21.7
Bottlebrush squirreltail	2.9
Other species **	45.9
Annuals	0.6
Total	115.5

819 ** These include mutton blue grass, little seed rice grass,
820 pine dropseed, prairie junegrass, little bluestem, sideoats
821 grama, mountain muhly, Arizona fescue and others.

822 **L.4.6 Silviculture**
823 Productive forest land is defined as those lands producing more than 20 cubic feet/acre/year of wood volume.
824 It is estimated that 50 percent of the forest land in the upper Rio Puerco area is nonproductive.

The following table shows the results of the 1974 BLM Forest inventory. The table represents basal area of all tree species in the area.

Table L-36: 1974 BLM Forest Inventory Results, In Square Feet

Plot No.	Chijuilla-Cuba Mesa Area	I.C. Grant Area
109	18.9	-
110	-	28.4
115	18.0	-
116	18.6	-
11.7	-	72.8
118	-	27.3
127	48.6	-
128	32.7	-
129	-	22.2
134	12.6	-
136	29.9	-
139	16.2	-
140	17.9	-
141	15.7	-
142	29.8	-
145	19.5	-
146	26.0	-
148	-	72.0
152	-	46.3
153	-	51.7
154	-	39.2
155	-	82.5
159	-	45.2
160	-	45.7
161	-	62.9
162	-	16.4
163	28.0	-
164	-	118.8
165	-	41.8
166	-	74.1
170	35.4	-

Studies show that the combined economic value of grazing and saw log production would be maximum in tree stands having basal area of about 45-60 square feet/acre. The inventory above shows that the majority of the ponderosa pine in the upper Rio Puerco area was (in 1974) below the recommended basal area. All areas exceeding the recommendation were located on the Ignacio Chavez Grant, which has since been designated Wilderness study area.

Historically, in the southwest, the most exceptional conditions for natural regeneration of Ponderosa pine occurred when heavy seed production in the fall of 1918 was followed by a warm, wet spring and summer in 1919. Soil surface conditions were probably also unusually good because of heavy grazing during World War I. As a result, thousands of seedlings per acre were established on most of the open areas of the Ponderosa pine forests.

According to the Soil Conservation Service, Soil Survey of Sandoval County, the site index for ponderosa pine in the Sedmar loamy sand areas of Chijuilla area ranges from 51 to 53. Based on a site index of 50, the potential production per acre of merchantable timber is 2,500 cubic feet or 9,200 board feet (International rule, 1/8-inch kerf) from an even-aged, fully stocked stand of trees 100 years old. The culmination mean annual increment (CMAI) is 38 cubic feet per acre per year occurring at age 60 or 130 board feet (International rule, 1/8-inch kerf) per acre per year occurring at age 200.

The main concerns in producing and harvesting ponderosa pine in the upper Rio Puerco are:

1. Water erosion
2. Seedling mortality
3. Windthrow hazard
4. Plant competition
5. Slow growth
6. Damaging agents (disease, and insects)

In the Chijuilla area, seedlings are subject to high mortality rates because of the sandy soils. The low available water capacity reduces seedling survival in areas where understory plants are numerous. Trees are subject to windthrow because of limited rooting depth. Plant competition, from piñon and juniper delays natural regeneration, but does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as Gambel oak and big sagebrush limit natural regeneration of ponderosa pine. Herbaceous plants also compete for soil moisture for many years after a tree planting. Moderate grazing levels should control understory production and allow tree seedlings a chance to become established.

Tree growth in the upper Rio Puerco is slow, therefore thinning should be used to release and accelerate growth on desirable trees.

Damaging Agents

Ponderosa pine foliage feeding insects:

Leaf beetle	Pine tussock moth
Scarab beetle	Cutworm
Pine reproduction weevil	Pine needle sheathminer
Elegant pine weevil	Needle miners
Sugarpine tortrix	Pine adelgid
Pine butterfly	Black pine leaf scale
Pandora moth webworm	Pine scale
Douglas-fir tussock moth	Pine sawflies

Diseases:

Southwestern dwarf mistletoe *(Arcenthobium vaginatum)*—39 percent of the Ponderosa pine forests in New Mexico and Arizona are infected.

Root diseases caused by Armillaria sp. and *Heterobasidion annosum*.

Stem rusts-*Cronartium arizonicum, Peridermium filamentosum*, and *P. harkenessi.*

Needle cast damage by *Lophodermella cerina* and *Davisomycella ponderosae*.

Cankers caused by *Atropellis piniphila*.

Decays such as red rot caused by *Dichomitus squalens*, Red ring rot, *Phellinus pini*, and others.

Other environmental factors that limit ponderosa pine growth:

- Climatic extremes
- Winter drying
- Top kill due to cold
- Frost damage to foliage
- Drought
- Salt toxicity-soil salinity
- Hail damage
- Air pollution-ozone
- Lightning

Wildlife

Mammals:

Merriam shrew	Colorado least chipmunk	Porcupine
Little brown myotis	Rock squirrel	Coyote
Long-eared myotis	Golden-mantled ground squirrel	Gray fox
Fringed myotis	Botta's pocket gopher	Black bear
Long-legged myotis	Western harvest mouse	Raccoon
Small-footed myotis	Deer mouse	Ringtail
Spotted bat	Rock mouse	Long-tailed weasel
Big brown bat	White-footed deer mouse	Striped skunk
Hoary bat	White-throated woodrat	Spotted skunk
Cottontail rabbit	Mexican woodrat	Mountain lion
Abert's squirrel **	Meadow vole	Bobcat
Red squirrel (chickaree)	House mouse	Mule deer
Cliff chipmunk		Elk

** obligate species

Birds:

Sharp-shinned hawk	Black-chinned hummingbird	Barn swallow
Cooper's hawk	Broad-tailed hummingbird	Cliff swallow
Red tailed hawk	Rufous hummingbird	Violet-green swallow
Golden eagle	Acorn woodpecker	Steller's jay **
Peregrine falcon	Lewis's woodpecker	Common raven
Merriam's turkey *,**	Yellow-bellied sapsucker	Clark's nutcracker
Band-tailed pigeon	Williamson's sapsucker	Mountain chickadee
Barn owl	Downy woodpecker	Bushtit
Screech owl	Ladder-backed woodpecker	White-breasted nuthatch
Flamulated owl	Hairy woodpecker	Pigmy nuthatch
Great horned owl	Cassin's kingbird	Brown creeper
Pigmy owl	Western flycatcher	House wren
Long-eared owl	Hammond's flycatcher	Canyon wren
Saw-whet owl	Dusky flycatcher	Rock wren
Whip-poor-will	Gray flycatcher	American robin
White-throated swift	Black phoebe	Hermit thrush
	Western wood-pewee	Western bluebird

Townsend's solitaire	Grace's warbler	Purple finch
Ruby-crowned kinglet	MacGillivray's warbler	Lesser goldfinch
Solitary vireo	Western tanager	Pine siskin
Warbling vireo	Hepatic tanager	Red crossbill
Orange-crowned	Black-headed grosbeak	Green-tailed towhee
warbler	Lazuli bunting	Dark-eyed junco
Yellow-rumped warbler	Cassin's finch	Oregon - slate-colored junco
Townsend's warbler	House finch	Chipping sparrow

* Merriam's turkeys feed on piñon pine nuts, Gambel's oak acorns, and various grass seeds and Eriogonum during the fall and winter.
** Obligate species

Lizards

Eastern fence lizard	Great plains skink
Greater short-horned lizard	Many-lined skink
Ornate tree lizard	Arizona alligator lizard

Snakes

Night snake	Milk snake
Desert-striped whipsnake	Kingsnake
Mountain patch-nosed snake	Western (prairie) rattlesnake
Gopher (bull) snake	Western diamondback rattlesnake

Amphibians

Woodhouse's toad

Arizona fescue and mountain muhly should be considered key or desired management grass species in the Ponderosa pine ecosystem. Other species almost as important are mutton bluegrass, prairie junegrass, western wheat grass, little bluestem, sideoats grama and pine dropseed.

Growth begins on Arizona fescue and mountain muhly about mid-April to early May depending on air temperature and precipitation. Despite similar dates for growth initiation, Arizona fescue is a cool season grower and mountain muhly is a warm-season grower on ponderosa pine ranges, two periods of deferment should be considered to maintain vigor of both species. The period for cool season grasses is April 10 to July 1 and the period for warm season grasses is July 15 to October 15.

L.4.7 Fire

Historically, fire has played a major role in the ponderosa pine forest. Climatic wet cycles often followed by dry cycles have set the stage for periodic fires in this ecosystem. When tree litter becomes too deep and numerous, terpenes in the litter inhibit the nitrogen cycle. To maintain the open stands of ponderosa and the herbaceous understory, prescribed fire should be considered in the overall management of the forest. This will prevent conditions building up to a catastrophic wild fire that will damage the watershed.

L.4.8 Visual Resources

Timber harvesting activities can create significant visual impacts due to the scale of actions. Visual impacts of roads are the scenic quality of the road corridor, viewed from the road, and the visibility of the road as a more distant landscape feature.

Initial, disruptive appearance of harvested trees usually seen from roads or other travel is exacerbated by soil disturbance and slash. On the other hand, small scale or selective harvest activities can serve to improve scenic quality of forest areas.

Far views showing incongruent vegetation patterns or road scars provide negative visual impacts. Timber harvest activities may also impact air and water quality, damaging esthetic values. Livestock production in Ponderosa pine forests takes place primarily in the summer and early fall seasons. While this is also the period of heaviest recreational use, the negative impacts of livestock production on recreation are mostly indirect involving fixed facilities (fences, corrals, buildings, tanks) and induced vegetative changes. On the other hand, the presence of livestock in the forest in common dispersed patterns may contribute a romantic sense of southwestern tradition to wildland recreation experiences.

L.4.9 Desired Plant Community--Percent Composition (By Weight):

Trees---15%

Ponderosa pine	Gray oak
Piñon pine	Rocky mountain juniper
Gambel's oak	Alligator juniper (Cibola Co.)
Wavyleaf oak	Douglas-fir
Quaking aspen	

Grasses--60%

Arizona fescue	Sideoats grama
Mountain muhly	Western wheatgrass
Mutton bluegrass	Fox tail barley
Prairie junegrass	Bottlebrush squirreltail
Little bluestem	Wolf tail
Pine dropseed	Nodding brome
Threadleaf sedge	Spike muhly
Hairy grama	Blue grama

Shrubs--5%

Wax or Squaw currant	New Mexico locust
Wild rose	Chokecherry
Snowberry Rock spirea	Mountain mahogany
Colorado barberry	Elderberry

Forbs--5%

Globe mallow	Geranium	Rockcress
Wild iris	Golden pea	Strawberry
Western yarrow	Penstemon	Louisiana wormwood
Lupine	Filaree	Fringed sagewort
Deer vetch	Aster	Buckwheat
Groundsel	Indian paintbrush	Wild onion

L.5 THE RIPARIAN AND WETLAND ECOSYSTEM

L.5.1 Introduction

Riparian-wetland areas comprise a very small percentage (less than 1 percent in the Rio Puerco Field Office area) of our Public Lands in New Mexico, yet these unique areas have the highest levels of species richness or diversity of all southwest ecosystems. They provide a special niche for flora and fauna not seen in the surrounding, arid, upland landscape. These areas provide sediment control, recharge ground water, and absorb and reduce the energy of floodwaters. They provide water, food, cover, and shade for wildlife and livestock. They are also important focal points for water based recreation activities. Their importance for conserving biodiversity and reducing nonpoint source water pollution is unquestionable.

Water is the primary factor controlling the environment and the associated plant and animal life in the riparian-wetlands. These transitional habitats occur between upland and aquatic environments where the water table is at or near the surface of the land.

Water has a high specific heat, which means that it gains or loses a large amount of heat before its temperature changes appreciably. This property of water moderates seasonal, daily, and local extremes of temperature. Aquatic ecosystems do not show the pronounced microclimatic variability of many terrestrial systems.

The freshwater wetlands can be divided into lacustrine, associated with lakes; riverine, associated with rivers and streams; and palustrine, associated with marshes, swamps, and bogs.

Most wetlands are dominated by hydrophytes, or wetland plants. These can tolerate various degrees of flooding or live in frequently saturated areas. Most wetlands are characterized by fluctuating water levels and by soils that are distinctly different from those of the dry, adjacent upland areas.

Wetland trees and shrubs have several unusual adaptations for coping with low levels of oxygen. Some, such as willow and ash, are stimulated when flooded to produce new, air-filled roots to replace those that the floods have killed. Flooding can also promote the growth of tiny openings in the bark, called lenticels, which allow air to move more readily into the plant. Some species are capable of switching to oxygenless, or anaerobic, respiration. Cottonwoods need periodic flooding for seed germination and seedling establishment.

The gallery forests of Fremont cottonwood, which once covered the Rio Puerco floodplains, were often close to early settlements. Trees were cut initially for fuel and shelter purposes such as ceiling beams or "vegas" for adobe buildings. These riparian trees were also cut to clear land for agriculture and urbanization. Much of the heavy utilization of the gallery forest trees had subsided by the beginning of the twentieth century.

The downcutting and entrenchment of the Rio Puerco that began between 1885 and 1890, caused water tables to drop, reducing the extent of the riparian habitat. When the benches and terraces of the Rio Puerco were flooded, cottonwood sprouts and seedlings, which are highly relished by livestock, were severely browsed along with the willows.

Some of the old age survivors are visible today from Cuba to San Luis along the Rio Puerco. Continued destruction of cottonwoods and willows changed the available water regime. This set a perfect stage for the establishment and explosive expansion of introduced/non-native shrub-tree species such as saltcedar (Tamarix spp.) and Russian olive (Elaeagnus angustifolia).

If gallery forests were allowed to regenerate and mature, the resulting heavy shade would likely curtail the reproductive success of saltcedar and eventually only a few individuals would be left in the understory.

In the Rio Puerco riparian-wetland ecosystem, there are certain plants or organisms that are more important than others. In the Rio Puerco, the Fremont or Rio Grande cottonwood should be the dominant species and form the main tree canopy. Beneath the cottonwoods, a shrubby layer of willows should develop. Below the willows an herbaceous layer of rushes, sedges, and other aquatic plants should occur at the water's edge. This layering of vegetation is referred to as stratification. The Rio Puerco should have all three layers for maximum biodiversity.

The cottonwood/willow communities, once common along the Rio Puerco, are now threatened. The loss has been masked to most observers because many "historic" large old trees remain or have only begun to die, but these trees are not being replaced. This decline along some segments of the Rio Puerco is critical to the point of extinction.

Cottonwoods are considered a "keystone species" because the welfare of so many other plants and animals depend upon them. In many ways, riparian species such as large cottonwoods play much the same functional role that old growth species do in the temperate rainforests of the Pacific Northwest. Cottonwoods, because of their potentially large size, serve as virtual condominiums throughout much of the west too dry for extensive forest cover.

Many raptors (hawks, eagles, owls) and great blue herons roost in their branches, woodpeckers and bluebirds nest in cavities in their boles, and even some species of bats hibernate in cavities or under pieces of loose bark on dead trees. They furnish food and dam material for beavers also.

The life of a riverine wetland is influenced by many factors, including rapidity of flow, water temperature, oxygen and nutrient levels, and the nature of the bottom.

Most of the food energy to support the food chain of a riverine ecosystem is not the product of stream-dwelling plants; rather, it is from terrestrial ecosystems. Under natural conditions, leaf litter is probably the most important element in the basic nutrition of a stream.

In streams, the main sources of organic input or food for stream organisms include partly decomposed leaves or other organic material flowing downstream. This debris, or detritus, may be caught in the nets set by the larvae of such benthic macro invertebrates as caddisflies or stoneflies, which also glean the rocks for algae. These insects are in turn consumed by larger animals.

All of the uneaten leaves as well as twigs and dead branches that accumulate in the wetland are taken over by the decomposers: bacteria, worms, and benthic macro invertebrates that produce detritus. These creatures use some of the energy that resides in dead plant and animal remains, but in the process, also release mineral nutrients and soluble organic compounds that enable the riparian-wetland ecosystem to be self-perpetuating.

Streams like the Rio Puerco have high suspended sediments and have lower oxygen levels. Many benthic macro invertebrates cannot exist where there are small amounts of dissolved oxygen available on the river bottom.

Riparian-wetlands are living museums, where the dynamics of ecological systems can be taught. These outdoor laboratories can demonstrate such basic ecological principles as energy flow, recycling, and limited carrying capacity.

Riparian-wetlands--(BLM definition)

> "Zones of transition from aquatic to terrestrial ecosystems, whose presence is dependent upon surface and/or subsurface water, and which the influence of water reveals through their existing or potential soil-vegetation complex. Riparian areas may be associated with features, such as

lakes, reservoirs, estuaries, potholes, springs, bogs, wet meadows, muskegs, and ephemeral, intermittent or perennial streams."

L.5.2 Desired Plant Communities

The problem in trying to determine a desired plant community for riparian areas is: What was the community in the pre-disturbance state? A riparian ecosystem is constantly being disturbed. This ecosystem can also be looked at on a continuum ranging from the natural vegetation to the semi-natural to the other end of degraded, where the integrity of the system has totally been destroyed.

Much of the Rio Puerco riparian vegetative communities have been pushed beyond a point where they have lost much of their ecosystem integrity. Native species (Cottonwoods and Willows) have been replaced by exotic invaders (Saltcedar and Russian olive). This loss of native species has caused a reduction in biological diversity of not only plant species but wildlife species. Only fragmented stands of cottonwood/willow stands are now found along streambanks.

It should be ethical and economically beneficial to improve riparian zones in the southwest, even though some benefits are intangible. The following desired plant communities are submitted depicting general species composition, but no numerical percentages of each species or group of species are shown.

L.5.3 Vegetation

Riverine Riparian Plants

Rio Grande cottonwood	Blue grass	Cinquefoil
Narrowleaf cottonwood	Bent grasses	Yarrow
Plains cottonwood	Foxtail barley	Blue-eyed grass
Lanceleaf cottonwood	Desert saltgrass	Chickweed
Coyote willow	Mexican lovegrass	Monkey flower
Other willows	Sedges	Wild licorice
Chokecherry	Rushes	Field mint
Desert olive	Horsetail	Butterweed
Wild rose	Anemone	Selfheal
New Mexico locust	Hemlock	Inkberry
Currant	Monkshood	Waterleaf
Wheat grasses	Water parsnip	

Palustrine (Marsh) Wetlands Plants

Bull rush	Smartweed (knotweed)
Cattail	Buttercup
Water plantain	Arrowhead water cress
Spikerush	Bugleweed
Mare's tail	Flat sedge
Water speedwell	Water parsnip
Yellowcress	Beggar ticks
Pondweed	

L.5.4 Wildlife

Mammals

Little brown myotis	Small-footed myotis
Long-eared myotis	Spotted bat
Fringed myotis	Silver-haired bat
Long-legged myotis	Western pipistrelle

- Big brown bat
- Beaver
- Western harvest mouse
- Deer mouse
- White-footed deer mouse
- White-throated woodrat
- Meadow vole
- Norway rat
- House mouse
- Meadow jumping mouse
- Porcupine
- Coyote
- Raccoon
- Striped skunk
- Bobcat

Birds

- Great blue heron
- Cattle egret
- Snowy egret
- Black-crowned night-heron
- Green heron
- White-faced ibis
- Mallard
- Gadwall
- Northern pintail
- Green-winged teal
- Blue-winged teal
- Cinnamon teal
- American wigeon
- Northern shoveler
- Common goldeneye
- Bufflehead
- Ruddy duck
- Canvasback
- Ring-neck duck
- Common merganser
- Snow goose
- Canada goose
- Turkey vulture
- Sharp-shinned hawk
- Cooper's hawk
- Swainson's hawk
- Red-tailed hawk
- Ferruginous hawk
- Northern harrier
- Rough-legged hawk
- Osprey
- Golden eagle
- Bald eagle
- Prairie falcon
- Peregrine falcon
- American kestrel
- Great horned owl
- Scaled quail
- Wild turkey
- Sora
- Virginia rail
- American coot
- Sandhill crane
- Killdeer
- Mountain plover
- Solitary sandpiper
- Spotted sandpiper
- Least sandpiper
- Wilson's sandpiper
- Long-billed curlew
- Rock dove
- Mourning dove
- Roadrunner
- Common nighthawk
- White-throated swift
- Black-chinned hummingbird
- Broad-tailed hummingbird
- Rufous hummingbird
- Belted kingfisher
- Northern flicker
- Western kingbird
- Black phoebe
- Say's phoebe
- Horned lark
- Tree swallow
- Bank swallow
- Barn swallow
- Cliff swallow
- Violet-green swallow
- Common raven
- American crow
- Marsh wren
- Mockingbird
- Bendire's thrasher
- American robin
- Ruby-crowned kinglet
- Loggerhead shrike
- European starling
- Solitary vireo
- Orange-crowned warbler
- Common yellowthroat
- Yellow-breasted chat
- House sparrow
- Western meadowlark
- Red-winged blackbird
- Brewer's blackbird
- Brown-headed cowbird
- Northern oriole
- Western tanager
- Lazuli bunting
- House finch
- Purple finch
- Abert's towhee
- Savannah sparrow
- Song sparrow

Reptiles

- Lesser earless lizard
- Ornate tree lizard
- Great Plains skink
- Many-lined skink

Snakes

Gopher (bull) snake	Massasaugua
Black-necked garter snake	Black-tailed rattlesnake
Western garter snake	Western (prairie) rattlesnake
Glossy snake	Western diamondback rattlesnake

Amphibians

Tiger salamander	Red-spotted toad
Western spadefoot toad	Woodhouse's toad
Plains spadefoot toad	Leopard frog

Macro-invertebrates (scientific names only)

Callibaetis	Ceratopogonidae
Zoniagrion	*Gerris*
Tubificidae	*Notonecta*
Physella	*Ophiogomphus*
Simulium	Orthocladiinae
Argia	Simuliidae
Oreodytes	

Fish

Fathead minnow
Brown trout
Catfish
Chubs
Shiners
White suckers

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