



INTERPRETIVE RESOURCES
of the
PINON - JUNIPER ECOSYSTEM
in
NEW MEXICO



U. S. Department of the Interior
Bureau of Land Management
New Mexico State Office
Santa Fe, New Mexico

Prepared by: Rex L. Wells

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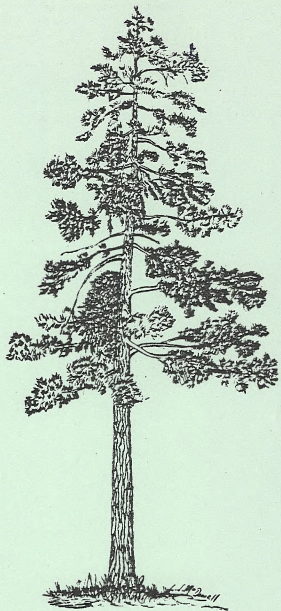


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A. INTRODUCTION

The piñon-juniper forest type occupies approximately 76 million acres in western North America, thus ranking as the largest woodland type in the world. In New Mexico, 17.2 million acres, or twenty-two percent of the forest lands, is piñon-juniper woodland. In acreage alone, this type assumes great importance.

Piñon-juniper is classified as "noncommercial" forest, meaning it has little timber value. Therefore, management has been limited and largely restricted to manipulation, chaining for example, to increase available forage for livestock.

The "noncommercial" designation does not mean the piñon-juniper type has no value. This forest is valuable wildlife habitat for deer, turkey, rabbits, and other species. About eighty percent of the total acreage in the west is grazed and supports $1\frac{1}{2}$ million animal unit months. It is exploited for timber products such as posts, poles, charcoal, and fuelwood. Statistics for the U. S. Forest Service Region Three (Arizona and New Mexico) estimated 43,650 noncommercial woodcutters taking an estimated 230,762 cords of wood in the period July 1, 1975 to October 1, 1976. For the same period, there were 11,735 convertible sales, the majority to commercial woodcutters. Some of the larger operations cut up to 300 cords. The piñon nut crop in the west averages one to two million pounds per year. In some states, piñon Christmas trees take about one-fourth of the market.

The predominant recreational uses of the type are dispersed activities such as hunting and related activities. Other recreation has been tied to other attractions such as archeological remains. Piñon-juniper has some drawbacks for intensive use recreation for it is in a semiarid environment and the small, often almost shrubby, trees offer little shade. However, in New Mexico, five of the six BLM development areas are in this type. The Aguirre Springs Recreation Site in the Organ Mountain Recreation Lands has been averaging over 100,000 visits annually.

The Bureau of Land Management has many responsibilities in addition to the construction and maintenance of recreation facilities. Today's visitor is interested in the environment and wants to learn more about it. Interpretation is an excellent media to help him achieve this objective and make his visit more enjoyable. From an agency standpoint, interpretation is valuable in motivating the user toward wise use of the land and its resources.



INTELLIGENT OBJECTIVES AND POLICIES

B. INTERPRETIVE OBJECTIVES AND POLICIES

Freeman Tilden, in Interpreting Our Heritage, defined interpretation as "An educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information." In this book, he also related six principles of interpretation:

1. Interpretation must relate to the personality or experience of the visitor.
2. Interpretation is revelation based upon information.
3. Interpretation is an art.
4. The chief aim of interpretation is provocation, not just instruction.
5. Interpretation should present a whole rather than a part.
6. Interpretation for children should not be a dilution of adult interpretation, but should be a separate program.

Objectives of an interpretive plan might be:

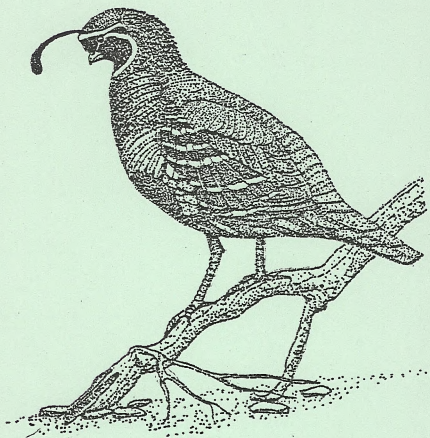
1. To expand the visitor's recreation experience to something more than just an outdoor visit.
2. To entertain, as well as inform, the visitor to add to the visitor's enjoyment.
3. To identify, preserve, and protect the natural and historic features located within the piñon-juniper type.
4. To make the visitor aware of the scenic, ecological, geological, and cultural resources of the piñon-juniper type and instill an appreciation

- for these resources in the visitor.
5. To motivate the visitor toward wise use of the land and its resources.
 6. To assist the visitor in understanding the role of the Bureau of Land Management in resource management.

Policies which might be incorporated into a plan are:

1. The initial interpretive developments should be in those areas in the piñon-juniper type normally accessible to and frequented by the largest number of visitors.
2. Interpretive services should be provided only when and where it is possible to provide programs or services of high quality. Anything less is detrimental to the public image of, and attitudes toward, the Bureau of Land Management.
3. Initial interpretive developments should be designed to require a minimum use of personnel for interpretive purposes.
4. Interpretive developments should be designed to give the feeling of relaxation, ease, simplification, and understanding. They should meet functional needs and harmonize with and complement the natural environment.
5. Subject matter presented in exhibits, signs, or other interpretive facilities and activities should be selected for interest and value to the visitor.
6. Discussions or statements concerning resources, places, events, organizations, or persons should be positive, contain fact, and should not contain derogatory statements or connotation.

7. Interpretation should be planned in consideration of the very young persons as well as the adult generation.
8. Personnel meeting and dealing with the public should be skilled in making presentations; they should be trained and knowledgeable in the subject matter; and their attitudes toward the BLM and the public should be receptive and positive.
9. Where practicable, all interpretive facilities should be designed to accomodate handicapped visitors.
10. Facilities and interpretation should be designed to make the visitor an active participant in the interpretation and not just a passive reader or listener.



INTERPRETIVE
MEDIA

C. INTERPRETIVE MEDIA

The method in which a message is presented can greatly influence the message itself. Imagination in presenting material can reinforce and enhance the information so it is better appreciated and longer , remembered.

Several types of media exist which can be used in interpretation. Wise use of each medium and combinations of media make it possible to attract and hold the attention of the visitor.

People receive information about the world through all of the senses - sight, touch, smell, hearing, and taste. When more than one sense is stimulated, the chance of retention of the information is greater.

This should be considered in the media selection.

1. Personal Services

Personal services are considered by many to be the ideal interpretive method when they can be used. Direct personal communication has the distinct advantage of being alive, can be tailored to the needs of various groups, and can adapt to a wide variety of circumstances. Material can be treated in more depth, and it is possible to have two-way communication and immediate feedback. The interpreter's personality can enhance the experience and the uniform gives credence to the interpretation. Types of programs include general talks, guided walks, campfire programs, and demonstrations.

2. Audio Messages

Recorded message repeaters allow long messages, which might not be read by most visitors, to be conveyed. Complex graphics can be simplified because the need for labels is eliminated. Scenic drives can be interpreted by transmitting the message by AM or FM radio.

3. Exhibits

a. Information Centers

An exhibit center provides an opportunity to display pictures, maps, dioramas, and real objects which might not be seen otherwise. Displays can be viewed at the visitor's discretion and at his own pace. The exhibits are available during bad weather or when other conditions restrict outdoor activities. The center acts as an introduction to the remaining subject matter, and can create interest and a desire to explore further.

b. Wayside Exhibits

Wayside exhibits give the interpreter a chance to be specific. By capitalizing on the motivating quality of a specific feature, usually unique or outstanding, more can be conveyed than before, after, or away from the feature. These exhibits are valuable for the handicapped, as they can be used without having to leave their vehicle. However, wayside exhibits can be used to encourage people to get out of their cars and use trails or other facilities.

4. Self-guiding Trails and Tours

Self-guiding trails are relatively inexpensive to construct, maintain, and change and can serve large numbers of people. Interpretation can be combined with hiking, riding, photography, and other activities. The visitor can use the trail whenever he wishes, and can proceed at his own pace.

The trail or tours enables the visitor to see features in their normal or natural setting. He can become part of the act of interpretation and can use all his senses.

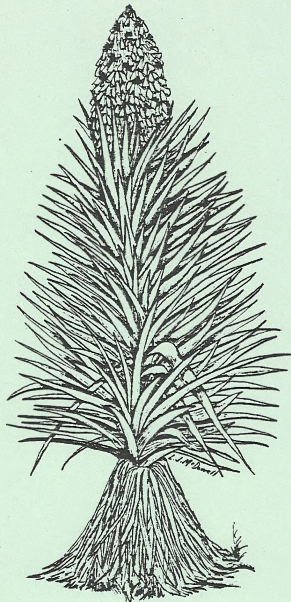
5. Publications

Publications can be carried and used when and how the visitor wishes. Pamphlets can be used for self-guiding trails instead of descriptive signs and allow pictures and more detailed text to tell a more complete story. References can be cited which permit the visitor to explore further on a particular subject. Publications can be prepared to treat the same subjects at different levels to serve both children and adults. These books have great souvenir value, and can be sold to offset printing costs.

6. Slide Programs

Slide programs enable the interpreter to reach people who are not, or possibly cannot be, on the site. The shows can be given in the information center during bad weather when trails and other facilities are closed. Programs can be given to schools, clubs,

or other organizations to educate the public or to stimulate interest in an area or a resource.



HOW THIS DOCUMENT CAN BE USED

D. HOW THIS DOCUMENT CAN BE USED

The objective of this document is to provide guidance for interpretive development in the piñon-juniper forest type. This paper is not site specific. Therefore, it does not make decisions on number, kind, or design of facilities or exhibits.

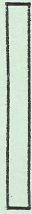
The intention of the document is to provide a number of interpretable facts relating to piñon-juniper. These concern factors which should be present in most places in New Mexico where the type occurs. Because this document is general in nature, interpretable features that are local and concern a specific site or area are not included.

Two bibliographies are included at the conclusion of the document which can be used to gather more detailed information. The first bibliography lists the references used for the interpretive resources inventory. Sources for each subject are referred to this bibliography by number. The second bibliography cites publications that could be useful in the preparation of an interpretive plan.

This document cannot, and does not, include all of the interpretable resources which are present in the piñon-juniper type. However, it is hoped this document will supply some base information and stimulate the creativity of the persons who will design the more detailed and specific interpretive plans.



INTERNETIVE SPECIMENS INVENTORY



E. INTERPRETIVE RESOURCES INVENTORY

Interpretation on the site is generally in two categories: orientation and enrichment.

Orientation refers to what and where information, narrating things to see and do while in the area. As this information is site specific, this document does not deal with orientation.

Enrichment information is designed to make the visitor's experience more meaningful and more than just an outdoor visit. This communication usually concerns environment or history to give the visitor a greater understanding of the area he is visiting.

Following are inventory sheets for some of the interpretive resources in the piñon-juniper ecosystem. Each sheet lists and describes a subject and shows the sources used in case further information is desired.

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INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Seed Dissemination

There are several ways seeds are dispersed: wind, water, animals, and the plants themselves. In order to take full advantage of a particular disseminating agent, plants have formed many adaptations of their fruits and seeds.

Some plants have adapted so they are not dependent on other forces to spread their seeds. A common adaptation is dehiscence, in which the fruits open at maturity. This can be passive and the fruits simply open and the seeds are shaken out by the wind or animals. In other cases, the very act of dehiscence forcibly ejects the seeds. In dwarf mistletoe, the fruits explode at maturity and cast seeds for several yards. The seeds are sticky and adhere to the bark of trees on which mistletoe is parasitic. Dehiscence is a somewhat inefficient means of dispersion as the seeds never go more than a few yards from the plant.

Wind is probably the most effective dispersal agent, at least as far as numbers carried is concerned. Two of the more common adaptations are wing-like appendages and hairs on the seeds. These are designed to slow the descent to the ground so the wind can carry the seeds further. Many pines, including ponderosa pine, have winged seeds. Dandelion seeds have a crown of hairs which spread out like a parachute. Russian thistles break off at the root at maturity and become tumbleweeds. As the wind blows them along the ground, the seeds are scattered.

Water is important because it can carry seeds and fruits long distances. However, water institutes decay and if the seed is in the water too long, it may not germinate.

Burs, as on cockleburs, and other hooked appendages catch passing animals and are distributed. Other plants, such as junipers, have edible fruits. The fruit is eaten and the seeds are passed through the animals. Many times, the chemical action of digestion on the seeds enable them to germinate faster than other seeds. Animals are efficient disseminators as they frequent the same types of vegetation most of the time, and seeds are apt to be dropped in places suitable for their growth. Animals can hinder dissemination by eating many seeds including those of pifion and oak.

Man is an important dispersing agent and acts in the same way as other animals. But cars, trains, ships, and other forms of transportation can carry seeds further than most other animals.

Sources: 33, 45

INTERPRETIVE RESOURCES INVENTORY

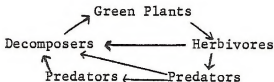
General Category: Ecology

Subject: The Food Chain

Green plants are the foundation upon which all other life is built. Through photosynthesis, plants are the source of all food and oxygen.

The food chain is not really a chain, but rather a cycle. Plants obtain nutrients from the soil and water and manufacture food. Plants are eaten by herbivores, which, are in turn, eaten by predators. These predators may be eaten by other predators. When plants or animals die, either by natural causes or predation, the remains are broken down by decomposers. The decomposition returns nutrients to the soil so they can be used by green plants, and the cycle is continued.

The Food Chain



To stay alive, plants and animals must continually use energy. Because of this, there is less energy available to each successive link in the chain. With the exception of the decomposers, the number of organisms decrease with each food level just as the energy does. There are more plants than herbivores and more herbivores than predators. Also, there is less specialization with each step in the cycle. Many plant-eaters, especially insects, feed on only one kind of plant, but most predators eat many animals.

Predation is important in keeping populations in balance and in weeding out the sick and the weak. An uncontrolled population would destroy its habitat, and eventually cause mass starvation for itself and the predators which depend upon it. Faster-breeding populations, such as rodents, are important as buffers between predators and larger slower-breeding mammals.

Sources: 17, 77

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Tree Anatomy

A tree is a system of many parts which fulfill many complex functions. The system is so efficient that a tree can grow over a hundred feet in height and live for centuries. Yet only about one percent of the tree is actually living. These living parts include cells in the roots, cambium, tips of twigs, and leaves. Most of the tree's bulk is the wood which is really "dead" tissue.

The leaves have many functions. They manufacture food through photosynthesis, admit carbon dioxide to be used to make food, and release oxygen and water vapor to the atmosphere. Each leaf has holes, called stomata, on the underside through which the carbon dioxide, oxygen, and water vapor can pass. The release of water vapor acts as air conditioning to cool the tree in order to maintain the correct temperature for photosynthesis, about 70° F.

The outer bark protects the tree from the weather, disease, fire, insects, and other animals. The inner bark contains cells through which food travels from the leaves to the cambium and the roots. The bark also conserves the tree's moisture content and insulates the tree in cold weather to prevent the moisture from freezing.

Just inside the bark is the cambium. This thin layer of reproductive cells produces new sapwood and new bark. The sapwood contains cells which transport water and minerals from the roots to the leaves, and stores food for growth and seed production. As the tree grows older, the older sapwood becomes plugged with resins and other substances. This is the heartwood which gives the tree rigidity.

The roots anchor the tree and absorb water and minerals from the soil. Roots of many trees become infected with a fungus. This relationship between the tree and the fungus is symbiotic. The fungus greatly increases the root's water-absorbing surface and allows more water and minerals to pass into the roots. The fungus, in return, obtains food from the tree.

Sources: 21, 77, 78

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Life Zones

In the study of plants, ecologists have formed plant grouping known as life zones. These zones' boundaries are based on the altitude above sea level, and correspond to the changes in vegetation one might encounter while climbing a mountain. This ecological classification, like most others, is based on the vegetation. This is done because plants constitute one of the essential features of the landscape, are "out in the weather" all the time, and are readily visible to the observer.

The Lower Sonoran Zone in New Mexico generally is between 2,800 and 5,000 feet in elevation. Desert shrub is the typical "forest type," but there are no typical forest-type trees in this zone. The average annual precipitation is 8 to 12 inches and the average temperature is 61.6°F. This zone covers about 1/8 of New Mexico.

Approximately 2/3 of New Mexico is occupied by the Upper Sonoran Zone. The piñon-juniper forest type is characteristic of this zone which is from 4,500 to 8,000 feet. The average temperature is 52.7°F. and about 15 to 19 inches of rainfall in a year.

Ponderosa pine is the typical forest of the Transition Zone. Rising from 7,000 to 9,500 feet above sea level, this zone inhabits about 1/20 of New Mexico. This zone is cooler and has more rainfall than the Upper Sonoran, with averages of 42.8°F. and 19 to 23 inches, respectively.

Directly above the Transition Zone and between 8,500 and 12,000 feet, is the Canadian Zone. Typical trees of this zone are spruce, fir, and aspen.

The dwarf timberline forest of spruce and fir is characteristic of the Hudsonian Zone. The altitudinal boundaries of this zone are 11,000 to 13,000 feet.

Above timberline, from 12,000 feet and above, is the Arctic-Alpine Zone. No trees exist in this zone and vegetation is limited to those plants which can survive the Arctic-like climate.

Sources: 14, 15, 23, 30

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Succession

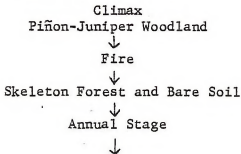
Biologic succession is the process of changing life forms - plants and animals - in an area over time. This sequence ends eventually in a climax community which is relatively stable as long as climatic and physiographic features remain the same. The species in a climax community are those which are best adapted to the existing conditions and can outcompete others.

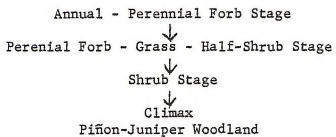
In dry areas, succession starts on a bare area, such as unweathered rock. Since the only plants that can live on bare rock are lichens, they are the first to become established. Lichens have a disintegrative effect on the rock and are helped by water, wind, and heat and cold in breaking down the rock. As a thin layer of soil is built up, mosses and other small plants can grow. These new plants add their effort in building up the soil.

As the soil is built up, its water-holding capacity increases and plants which are less drought-resistant become established. The plants reduce wind velocity over the soil to help keep it in place, provide shade, and, when they die, add organic matter to the soil.

Once there is enough soil, annual forbs appear, then come perennial forbs and grasses, then shrubs, and finally trees. At each stage in the succession, the environment is changed so the habitat become increasingly suited for the species of the next stage and less suited to the existing plants. This process occurs until the climax is reached and a stable community exists. The piñon-juniper forest is a climax community over much of the west because of the semi-aridity of most of the region.

Fire, landslides, chaining, grazing and other natural disasters and man-caused actions can return an area to a bare condition or an earlier stage in succession. This is termed retrogression. Succession will begin again from this point. The possible stages of succession of a piñon-juniper woodland after a fire are:





Sources: 33,45

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Cones

Except for a few species, modern trees can be classed as gymnosperms or angiosperms. Gymnosperms refers to trees where the seeds are born "naked" such as the pines, and angiosperms are those in which the seed is enclosed in an ovary like the apple tree.

The first trees were gymnosperms, conifers in particular, and can be traced back to the late Paleozoic Period. Angiosperms developed later than the conifers, possibly in the lower Cretaceous or late Jurassic Periods.

In gymnosperms, seeds are borne in the open, usually on the scales of a cone. The time for maturation varies from one to two years.

The development of piñon cones, like that of all pines, takes two years to complete and encompasses three growing seasons. Pine cones are characteristically bicolored: the darker portions being the first year's growth and the light-colored parts being the second year's growth. Most pine seeds are winged, but those of piñon are a wingless, round nut.

Stages of Development of Piñon Cones

First Growing Season

August - The winter buds containing the cone primordia start to form.
October - The winter buds are fully formed.

Second Growing Season

May - The buds swell and the scales around the cone are visible.
June - The cones are visible. Pollination occurs and the scales close.
July - There is rapid cone and nut growth.
August - The end of the season's growth.

Third Growing Season

May - The cones and nuts resume growth.
July - Fertilization occurs. The cones and nuts reach full size and the seedcoats harden and darken.
September - The cones and nuts mature and the cones open late in the month.
October - The entire crop of nuts have fallen by the end of the month.

The cones and seeds can be attacked by pests. The larvae of gall midges cause most of the losses during the first year of development. They cause the cones to shrivel, dry, and fall from the trees. During the second year, cones and seeds may be killed by the larvae of several species of moths and weevils and by piñon cone beetles.

In addition to attack by pests, the production of empty seeds is common. This is referred to as blighting or blasting. Blighted nuts may be of normal size but inside is only a small amount of dry, shriveled material. Usually, blighted nuts have a lighter-colored shell than normal nuts. Another method which can be used to detect blighted nuts is to put them in water. In most cases, blighted nuts will float and normal nuts will sink.

Sources: 35, 48

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Ecotones

The boundary between two distinct plant communities is called an ecotone. This boundary is usually a zone, which may vary in width, instead of a sharp line. This transition area incorporates some of the ecological features of both communities, but usually has a unique ecological structure of its own. Plants and animals common to both communities inhabit the ecotone, so the variety and density of plants and animals is usually greater than in either of the communities alone.

In some cases, an abrupt boundary line does exist. Some causes are: 1) an abrupt change in geological formations which causes a sharp boundary in soil type and the kinds of mineral nutrients available to plants; 2) a change in soil-moisture conditions, as between a swamp and a well-drained upland; 3) a sharp boundary in topography affecting local climate, as a knife-edged ridge separating north and south slopes; and 4) abrupt changes in vegetation caused by tornados, fire, fumes from smelters, and logging.

Sources: 42,48

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Pollination

Pollination is the transfer of pollen grains from the anthers to the stigma. The principal agents of pollination are animals, especially insects and birds, water, and wind. Whatever the method used, flowers have adapted to take full advantage of it.

Most trees and shrubs, including all conifers, are wind-pollinated. The pollen has evolved so it is light, smooth, and dry, thus, easily blown. Pine pollen is so well adapted to the wind that some have been known to be carried over 100 miles. Wind pollen also is not easily wetted because wet pollen cannot be carried readily.

In many wind-pollinated trees, the pollen is produced in catkins which hang downward and release pollen even in a slight breeze. In trees with flowers, the stamens have long filaments and the anthers are freely exposed to the wind. Wind is so inefficient in pollination the plants must produce great amounts. One pine or spruce staminate cone can release between one and two million grains of pollen. Juniper is also an abundant producer and juniper hay fever is common. Another adaptation in deciduous trees is the pollen is produced before the leaves develop so the leaves do not get in the way. The stigmas of the flowers are large and well-exposed to catch the pollen.

Insects are by far the most important animals in pollination. The color, odor, and form of the flower seem the determining factors for preference by insects, although more research is needed. Bees seem to prefer blue flowers, red seems to be the favorite for butterflies, and yellow or white is preferred by night-flying insects such as moths. Flies are pollinators of those flowers man thinks are foul-smelling.

Sources: 14, 21, 45

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Decomposition

Fallen leaves and other litter, including the bodies of dead animals, gradually accumulate on the forest floor until decomposition begins. Decomposition is the process by which the nutrients an organism utilized in its life cycle are returned to the soil for use by other organisms.

The surface of the soil supports one of the richest menageries of plants and animals of all ecological niches. This is true both in terms of numbers of species and weight per volume of space. For example, the bacteria alone in forest soil may weigh up to 1,680 kilograms per hectare (about 1,500 pounds per acre). In addition to bacteria, other organisms which are involved in decomposition are small mammals, worms, grubs, beetles, ants, centipedes, and fungi to name a few. Fungi are the chief agents of decomposition.

The rate of decomposition is determined by the palatability of the forest litter and the climate. Litter that is rich in calcium and other nutrients and not woody or leathery is decomposed faster. The climate affects the soil conditions. If there is sufficient warmth, moisture, and oxygen, organic matter is rapidly returned to the soil and litter does not accumulate.

Every organism is composed of elements that were once part of other living things. These "secondhand" or recycled elements have been used many times and will be used many times again. It is possible that an atom of any organism was once part of a dinosaur.

Sources: 21, 48, 77

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Tree Rings

Trees grow in diameter from the outside. Just underneath the bark is a thin layer of reproductive cells called the cambium. During each growing season, the cambium adds cells to the outside of the existing wood, thus increasing the diameter. This year-to-year growth forms distinct layers, or tree rings.

Tree growth responds more to water stress than any other site factor. Moisture stress affects the width of annual rings and the proportion of springwood (large, weak, thin-walled cells) to summerwood (small, strong, thick-walled cells). It is this response to stress which makes the science of dendrochronology possible.

Dendrochronology is the study of past events using tree rings. This science can be used by archeologists and climatologists. It is valuable in studying the climate and climatic cycles of past ages, and in dating structures in which wood was used in construction.

Trees of a given locality exhibit a similar pattern of annual rings. By comparing the rings of old living trees with those of logs taken from ruins, it has been possible to establish chronologies for the past 2,000 years in the American Southwest. Dates of construction of pueblos can usually be established using this method.

Tree ring studies can be utilized in studying past climatic cycles and events, including severe droughts. A severe drought between 1273 and 1285 was dated using tree rings from Mesa Verde National Park. This drought was probably one of the factors which led to the disappearance of the Anasazi of Mesa Verde.

A tree ring record is easy to make. To do so, a strip of paper can be tacked from the center of the stump to the bark. The paper is then rubbed with the broad edge of a soft-lead pencil. The annual rings will show up as dark lines alternating with lighter areas.

Sources: 48, 51, 77

INTERPRETIVE RESOURCES INVENTORY
General Category: Ecology
Subject: Piñon-Juniper Woodland

The piñon-juniper forest type inhabits about 76 million acres in western North America and is the largest woodland type in the world. Twenty-two percent, 17.2 million acres, of New Mexico is piñon-juniper. This type is generally referred to as a "woodland" because it is typically open, often very open, in character and the trees are generally below sawtimber size.

Piñon-juniper woodlands are, as a whole, the simplest woodlands in the Southwest as far as dominant plants are concerned. Typical plants in association with piñon-juniper include apacheplume, fendlerbush, oak species, blue grama, western wheatgrass, yucca, and cacti species to name a few. On the lower elevations, piñon-juniper overlaps with the communities of the Lower Sonoran Zone, characterized by sagebrush flats. At the upper limits, an interspersion with the species of the Transition Zone occurs. The ponderosa pine forest is typical of the Transition Zone.

The understory species, in general, decrease in density with an increase in density of piñon and juniper. This is caused by piñon and juniper being able to outcompete and suppress the other species. The suppression is due to shading, rainfall interception, water and mineral competition and litter. It has also been found that junipers exude active growth inhibiting substances from their roots.

The climate of this type is rather severe for tree growth. Representative conditions are deficient precipitation throughout the year, hot summers, high wind movement, low relative humidity, high evaporation rates, and much clear weather with intense sunlight.

Annual precipitation varies from 12 inches at the lower elevations to 18 inches at the upper limits of the type. As much as one-third can fall in July and August with the rest scattered throughout the year. Tree growth is more-or-less dependent on residual soil moisture from snow as much of summer precipitation is lost through runoff or evaporation.

Due to the harsh conditions, piñon and juniper grow relatively slowly. Piñon rarely exceeds three-fourths inch in diameter growth per decade. In a study in 1940 by Howell, juniper in Arizona and New Mexico seldom exceeded $\frac{1}{2}$ inch per decade in diameter growth.

Habitat for wildlife must contain cover, food, and water. Piñon-juniper provides cover and food for many species of mammals, reptiles, amphibians, and birds. This type is particularly important in the West as winter range for deer and elk. Mule deer are perhaps the dominant species ecologically in the piñon-juniper woodlands.

Principal enemies of piñon and juniper include various insects, rusts, blights, and mistletoe. Piñon especially is resistant to insects and disease and mortality is infrequent. Fire is seldom serious because of the openness of the stands. However, fire has been considered to be a natural factor that repels invasion of piñon-juniper into grasslands. The recurrence of fires is probably the main factor in maintaining grassland opening within piñon-juniper.

Sources: 1, 2, 14, 23, 33, 35, 36, 37, 47

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Piñon

Two kinds of piñon occur in the State of New Mexico: Pinus edulis, the common piñon, and Pinus cembroides, the Mexican piñon. Pinus edulis means pine with the edible nut, and Pinus cembroides signifies a pine which resembles the Swiss stone pine, Pinus cembra.

The common piñon, the most common tree in New Mexico, is found throughout most of the state and has been designated the state tree. It is usually a small, many branched tree, but can reach heights of up to 50 feet on good sites. The leaves, or needles, are dark green, between $3/4$ and $1\frac{1}{2}$ inches long, and borne usually in clusters of two, rarely three, and even more rarely, singularly. The bark is reddish brown, and furrowed into ridges.

The Mexican piñon is very difficult to distinguish from the common piñon. However, the nuts are larger and have darker shells and the needles are shorter, and are more common in bundles of three. The range in New Mexico is confined to the southwest corner of the state, from Fort Bayard southward.

Piñons have a moderately deep, widespreading root system and are characteristic of dry, shallow, gravelly or rocky soils of mesas, benches, and canyon walls.

Piñons are usually found in association with junipers, Gambel oak, and ponderosa pine at upper elevations. They provide cover and food for wildlife including deer, turkey, bear, squirrels, and javelina. Piñon is probably the most important tree in New Mexico for food for animals because of its wide range.

Piñon has a very distinctive fragrance due to the presence of ethyl caprylate which is not known to exist in the turpentine of any other pine.

Sources: 2, 14, 15, 35, 51

INTERPRETIVE RESOURCES INVENTORY
 General Category: Ecology
 Subject: Common Plants in New Mexico

Common NameBotanical NameTrees

Mexican Pifion	<i>Pinus cembroides</i>
Pifion	<i>Pinus edulis</i>
Oneseed Juniper	<i>Juniperus monosperma</i>
Rocky Mountain Juniper	<i>Juniperus scopulorum</i>
Alligator Juniper	<i>Juniperus deppeana</i>
Utah Juniper	<i>Juniperus osteosperma</i>
Redberry Juniper	<i>Juniperus pinchoti</i>
Ponderosa Pine	<i>Pinus ponderosa</i>
Gambel Oak	<i>Quercus gambeli</i>
Wavyleaf Oak	<i>Quercus undulata</i>
Gray Oak	<i>Quercus grisea</i>

Shrubs

Yuccas	<i>Yucca</i> sp.
Cholla	<i>Opuntia</i> sp.
Apacheplume	<i>Fallugia paradoxa</i>
Fendlerbush	<i>Fendlera rupicola</i>
Skunkbush	<i>Rhus trilobata</i>
Silver buffaloberry	<i>Sheperdia argentea</i>
Mockorange	<i>Philadelphus microphyllus</i>
Rabbitbrush	<i>Chrysothamnus</i> sp.
Mountainmahogany	<i>Cercocarpus montanus</i>
Big Sagebrush	<i>Artemisia tridentata</i>

Forbs and Grasses

Russian Thistle	<i>Salsola kali</i>
Prickly Pear Cactus	<i>Opuntia</i> sp.
Hedgehog Cactus	<i>Echinocereus</i> sp.
Thistle	<i>Cirsium</i> sp.
Blue Grama	<i>Bouteloua gracilis</i>
Three-awn	<i>Aristida</i> sp.
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Cheatgrass	<i>Bromus tectorum</i>
Wheatgrass	<i>Agropyron</i> sp.
Indian Ricegrass	<i>Oryzopsis hymenoides</i>

Sources: 2, 14, 33, 42

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Junipers

There are six species of juniper recognized as growing in New Mexico: common juniper (Juniperus communis), Rocky Mountain juniper (Juniperus scopulorum), oneseed juniper (Juniperus monosperma), Utah juniper (Juniperus osteosperma), alligator juniper (Juniperus deppeana), and redberry juniper (Juniperus pinchoti). Common juniper is a low-growing shrub, but the other five reach tree size. Generally, four of these five are so similar that it is difficult to pick out a single characteristic that identifies a specific species. Alligator juniper is easily identified by the bark which is broken into rough squares resembling an alligator's hide, hence the name. Junipers are commonly known as "cedars" because of the aromatic wood.

Juniper berries are actually cones, but the scales have grown together to make it appear like a berry. The berries range in size from 1/8 inch, in oneseed junipers, to 1/2 inch in alligator junipers. Juniper berries commonly ripen the same year they flower. However, it takes two seasons for berries of Rocky Mountain juniper and alligator juniper to mature.

Oneseed juniper is most common and most widely distributed juniper in New Mexico, Rocky Mountain juniper is the most widely distributed juniper in the West, and common juniper is circumpolar in the Northern Hemisphere. Alligator juniper grows the largest of the junipers in New Mexico and can be up to 65 feet high and 5 feet in diameter. The largest known alligator juniper is in the Fort Bayard pasture near Fort Bayard, New Mexico.

Junipers provide cover and food for many animals. Quail, turkeys, deer, and many songbirds use the trees for shelter. The foliage is eaten by deer, elk, antelope, desert bighorn, and Barbary sheep. The berries are eaten by foxes, bears, squirrels, chipmunks, deer, turkey, songbirds, and javelina. The shreddy bark of most junipers is often used for nest building by birds.

Sources: 9, 14, 32, 37, 51

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Ponderosa Pine

Ponderosa pine (Pinus ponderosa) is the most widely distributed pine in North America. Its range extends from British Columbia into Mexico and from Nebraska to the Pacific coast. It is the most common forest tree in the Southwest. Ponderosa pine is typical of the Transition Zone, and in New Mexico grows from 6,500 feet to over 10,000 feet above sea level. It intermixes with piñon-juniper at the lower altitudinal limits.

Ponderosa pine is the most valuable sawtimber tree in New Mexico. In Arizona and New Mexico, more ponderosa pine is cut than all other species in these two states put together. The wood is used for construction, boxes and crates, caskets, furniture, toys, piling, poles, and fuel. More millwork, cabinets, and interior trim are made from ponderosa pine than any other species in the United States.

This pine is also a prime producer of cover for wildlife. Probably the most typical game in Merriam's turkey, which utilizes the tree for food, shelter, and roosting. Young trees are browsed by deer, elk, and bear; bear eat the inner bark; and squirrels eat the young, tender shoots.

Ponderosa is derived from the Latin ponderosus meaning ponderous or heavy. Ponderosa pine attains large size - diameters of 30 to 50 inches and heights up to 130 feet are common. It also reaches old age. Overmature trees are commonly 300 to 600 years old, and one tree in Oregon was found to be over 700 years old.

Ponderosa pine is also known as western yellow pine, blackjack pine, pinabete, and pino real. Young trees generally have dark brown to black bark with small ridges, hence the name "blackjack." As the tree ages, the bark turns yellowish or reddish, and the ridges flatten into elongated plates. One distinctive characteristic of the bark is it smells like vanilla.

The needles are usually in groups of three, or in twos or threes on the same tree. They average about seven inches in length and are yellowish to grayish green. The cones are from four to six inches long, and the scales are armed with a slender prickle.

Ponderosa pine is drought and fire resistant, but is susceptible to insects and disease. Over 100 insects attack ponderosa pine, and diseases include blights, rusts, rot, fungi, and dwarfmistletoe.

Sources: 2, 9, 14, 23, 32, 51, 73

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: Lichens

Although they look like a single organism, lichens are actually a symbiotic relationship between a one-celled algae and a fungus mycelium. The mutualism of their union is sometimes questioned. Some biologists feel the fungus acts as a parasite and enslaves the algae. This theory is somewhat supported by the fact that algae in lichens commonly belong to a few well known genera, but the fungi have been so modified by the relationship they are very different from any other fungus. Another theory on lichens is the relationship is a dual parasitism, both the algae and fungus getting all it can from the other. Regardless of the type of relationship, it is considered the fungi obtains food from the algae and the algae get water from the fungi in return.

Lichens have a high degree of unity even though they are composed of two separate organisms. The vegetative reproductive body is composed of fungus enclosing some algal cells. This is one of the very few known cases of two organisms having a common reproductive body. The fungus does produce spores of its own, but they cannot develop unless they come in contact with suitable algae.

Another feature which makes lichens seem like a single organism is that they grow in very dry situations. Fungi, by themselves, are characteristic of moderately moist conditions. Algae are typical of very wet situations and many grow in water. Yet, when algae and fungi combine, the lichen is more resistant to dry conditions than any other group of plants.

Lichens grow on rocks, trees, and bare soil. When growing on rock, they help break it down into soil so other plants can become established. Lichens growing on soil have been found to reduce erosion of desert grassland soil.

Sources: 42, 45

INTERPRETIVE RESOURCES INVENTORY

General Category: Ecology

Subject: The Yucca and the Moth

The term symbiosis refers to a relationship of two organisms living together for the benefit of each other. Such a relationship exists between the yuccas and small moths which belong to the genus Pronuba.

Yucca flowers are pendulous and the style and stigma hang below the stamens but pollen cannot fall onto the stigma. The stigma is cup-shaped and the stigmatic portion is only on the inner surface. Yuccas cannot be wind-pollinated because the pollen is too heavy. Therefore, it is up to the moth to fertilize yucca flowers.

Shortly after sundown, female moths begin collecting pollen from the anthers and hold it in their specially constructed mouths. Usually, each moth flies to another flower, pierces the flower's ovary, and lays her eggs. Then she crawls down the style and places the pollen into the stigma. The fertilized flower produces many ovules, some eaten by the moth larvae (Yucca worm) and the rest maturing into seeds.

Each of the thirty species of Yucca has its own specific species of moth. With perhaps one or two exceptions, each moth will have nothing to do with any other yucca.

This symbiotic relationship is obligate for both the yucca and the moth. If the moth does not fertilize the yucca, no seed is produced. Without the yucca, there would be no fruit in which the egg could incubate. Thus, each species depends upon the other for survival. If the moths should ever fail to pollinate the yuccas, the ultimate end would be the extinction of both.

Sources: 26, 45

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Animal Signs

Many of the wild animals in an area are not seen by the recreation users. Some are nocturnal and are active when people are asleep or are just shy of humans. Knowledge and familiarity of animal signs - including tracks, droppings, gnawings, scratchings, rubbings, dams, nests, and burrows - give the recreation user evidence of the presence of unseen animals.

Most animals can be identified by their tracks. In addition, many exhibit a distinctive pattern of tracks which can help in identification if the tracks are faint or smudged. The pattern of tracks can also give a clue as to whether the animal was walking or running, maybe in flight from an enemy.

Making a collection of animal tracks is possible. Casts can be made by using plaster of Paris, wax or paraffin, or water putty. In order to get good, clear tracks, an area on a trail can be prepared by smoothing over an area of dust or soft mud.

Many times, droppings (scat) can be identified to particular animals just as tracks can be. Droppings also give an idea of what the animal has been eating and the season the food was eaten. For example, summer droppings of deer are soft and more-or-less flattened or formless, while winter droppings are hard and pellet-like.

Other signs which would be of interest are the girdling of trees by the gnawing of porcupines and scars in tree bark where deer have polished their antlers.

Sources: 20 (contains drawing of tracks)

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Common Animals in New Mexico

Common NameBotanical NameMammals

Mule deer	Odocoileus hemionus
Coyote	Canis latrans
Gray Fox	Urocyon cinereoargenteus
Striped Skunk	Mephitis mephitis
Porcupine	Erethizon dorsatum
Squirrels	Citellus sp.
Piñon Mouse	Peromyscus truei
Blacktailed Jackrabbit	Lepus californicus
Desert Cottontail	Sylvilagus auduboni
Deer Mouse	Peromyscus maniculatus
Apache Pocket Mouse	Perognathus apache

Birds

Piñon Jay	Gymnorhinus cyanocephalus
Scrub Jay	Aphelocoma coerulescens
Turkey Vulture	Cathartes aura
Common Raven	Corvus corax
Golden Eagle	Aquila chrysaetos
Red-Tailed Hawk	Buteo jamaicensis
Great Horned Owl	Bubo virginianus
Brown Towhee	Pipilo fuscus
Roadrunner	Geococcyx californianus
Poor-Will	Phalaenoptilus nuttallii
Common Bushtit	Psaltriparus minimus
Plain Titmouse	Parus inoratus
Ash-Throated Flycatcher	Myiarchus cinerascens

Reptiles and Amphibians

Western Diamondback Rattlesnake	Crotalus atrox
Bull Snake	Pituophis melanoleucus
Coachwhip	Masticophis flagellum
Tree Lizard	Urosaurus ornatus
Collared Lizard	Grotaphytus collaris
Horned Lizard	Phrynosoma sp.
Little Striped Whiptail	Cnemidophorus inornatus
Striped Whipsnake	Masticophis tæniatus

Insects

Juniper Cerambycid Beetle
Lady Bug
Mosquito
Horse or Deer Fly
Piñon Grasshopper
Yellow Jacket
Honey Bee
Pentotomid Bug
Walking Stick
Wood Tick
Eleodes Bug

Tetraopes femoratus
Hippodamia convergens
Culex pipens
Silvius sp.
Trimerotropis cyanea
Polistes sp.
Apis mellifera
Peribalus limbolaruis
Diapheromera femorata
Dermacentor sp.
Eleodes armata

Sources: 17, 42, 52

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Mule Deer

Like the jackrabbit, the mule, or burro, deer gets its name from its large ears. This large, gray deer ranges mainly west of the Continental Divide from central Canada to central Mexico. However, it is found in the Badlands of North Dakota, hundreds of miles east of the Continental Divide. In New Mexico, it is found throughout the state except for possibly the level, open grasslands of the eastern counties.

Mule deer are distinguished from white-tailed deer in two major ways. The mule deer's tail is either all black or black-tipped, while the white-tailed deer has a large, all-white tail as its name implies. White-tailed deer run like a horse. Mule deer, however, have a bounding, pogo-stick gait, all four feet coming down together.

Mule deer are large and a buck will average about six feet in length and weigh around 150 pounds. The antlers, borne by bucks only, are impressively large. The measurement between the burr, the place at the base of the antler where it is attached to the head, and the first fork is greater than any other deer native to the Southwest. Normally, the antlers will increase in size each year until maturity, then stay about the same for several years. In old age, they may decrease in size until they are as small as a young deer's. As with size, the number of points does not necessarily reflect the age of the deer. The Western tradition of counting points numbers one side only; in the East, the number of points on both sides are counted.

Predators on mule deer include coyotes, foxes, wild dogs, mountain lions, bobcats, eagles, hawks and ravens.

Deer are browsers. They feed primarily on the leaves and twigs of oak, juniper, piñon, ponderosa pine and mountain mahogany. When feeding on small trees, they sometimes straddle, or "ride," the tree down in order to get to leaves they could not otherwise reach.

Sources: 20, 27, 53, 56, 62, 77

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Coyote

The coyote is probably the most widely distributed mammal in the United States at the present time, having been reported in all the contiguous states except Delaware. It is very adaptable, inhabiting all life zones except perhaps the Arctic-Alpine Zone. The coyote has been known to live within the corporate limits of cities, including Los Angeles.

The coyote's generic name, Canis latrans, means barking dog. It resembles a small, lean, gray-colored German shepherd and seldom weighs over thirty pounds. Coyotes usually mate for life and litters normally number four to six pups. A pup's diet consists of milk and solid food which has been eaten by parents and regurgitated.

Like man, coyotes are omnivorous - they eat both meat and vegetables. Plant food includes melons, dates, juniper berries, succulent roots, cactus fruits, berries, herbs, and grass. They prey on birds, rabbits, gophers, snakes, squirrels, rats, mice, antelope, and deer. The favored method of killing deer is to outnumber the deer (six to ten coyotes to one deer) during the winter when the snow is crusted. The lightweight coyotes run on top of the snow, but the heavier deer breaks through the crust with each step. When the deer becomes exhausted, the coyotes can move in for the kill. The coyote has been much maligned by cattle and sheep growers, but they are very important in controlling rodent populations.

In legends, the coyote has been a villain, a fool, and even a creator. Early man seemed to think of him as a fellow being: subject to the hardships of primitive life, intelligent enough to maintain his niche, and subject to all the shortcomings of human nature. In the Southwest, one superstition is that a howling coyote turns into a ghost at night, and not even a gun can harm him.

Sources: 25, 27, 53, 56

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Porcupine

The porcupine is perhaps the most unique animal in North America because of its quills. These quills are actually modified hairs which cover the porcupine except for the underbelly. They range in size from one inch long and no thicker than a fine pencil lead, to up to four inches long and as thick as a wooden matchstick. Along the shaft of the quills are small barbs. In experiments, the barbs flare away from the shaft when placed in warm water. This is probably what occurs when they are imbedded in flesh and makes extraction difficult.

The quills are the porcupine's defense and its weapons. When attacked, it buries its head between the forelegs and turns so its rump is toward the attacker. When the enemy comes close enough, it attempts to strike with its tail. The loosely attached quills become imbedded in the attacker's skin. Many people believe the quills can work their way through the body. This is really due to muscular action by the victim, and the barbs prevent retreat. Ernest Thompson Seton estimated an adult has some 30,000 quills. His logic was: since 30 quills are enough to defeat a dog, one porcupine can defeat 1,000 dogs. The quills cannot be thrown, but are just easily withdrawn from the porcupine's body.

The porcupine's typical gait is a slow waddle. When feeding on the ground, most of its weight is supported by the hind legs and the forefeet are used to gather in plant stalks. They have poor eyesight, and food is selected by taste or smell. Porcupines are thought to eat mainly bark, but this is not true. In spring and summer, they browse on tender leaves and twigs. During fall and winter, more mistletoe and pine needles are eaten than bark. An uncommon trait of porcupines is they drink like a horse, putting their mouth under water and drawing in large gulps.

A porcupine gives birth to only one young each year. Fortunately for the mother, the quills are soft and harmless at birth, but within a few hours are hard enough to provide protection. The young begin eating tender grass and herbs almost immediately. Within a few months after birth, the young are entirely weaned and on their own.

Sources: 28, 53, 56

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subjects: Jackrabbit

The jackrabbit is not really a rabbit, but is a hare. Two main, and easily remembered, differences concern birth. Rabbits are born naked and blind, but hares have open eyes and short, but thick, coats of fur at birth.

With the exception of a few species of bats, hares have the largest ears in relation to body size of all mammals. The ears are the derivation of the name jackrabbit, which is shortened from the original name of "jackass rabbit." These large ears are very effective sound gatherers, may act as umbrellas, and act as radiators. For physiological reasons, the jackrabbit cannot allow its body heat to exceed 105° F or it may die. In the desert, there are many days over 100° F. The numerous capillaries in the ears give off heat to the air to cool the body.

Jackrabbits have great speed. They have been clocked between forty and forty-five miles per hour, and even up to fifty miles per hour for short distances. There is no predator in the Southwest that can match this speed.

Jackrabbits are well-adapted to their environment. Their very keen eyes are slightly protuberant, and they can see almost full-circle to catch sight of predators. They drink water, but mostly utilize their food for necessary moisture. In the Bible there is a passage that people should not eat camels, hares, or coneys because "they chew the cud, but divide not the hoof." Hares are not true cud-chewers, but, especially those of sparsely vegetated, semi-arid regions, practice coprophagy or re-ingestion of feces. Food passes rapidly through the digestive system and is excreted in soft pellets. These pellets are then re-eaten for their nutrients.

There are many legends concerning jackrabbits. The Pueblo Indians have a story similar to Uncle Remus' Brer Rabbit and the Tar Baby. The Mojave Indians would not kill jackrabbits because they believed departed spirits returned to earth as rabbits or quails. To kill a rabbit would destroy the soul of a dead ancestor. A western "tall-tale" is the jackalope, a fictional cross between an antelope and a jackrabbit.

Sources: 11, 25, 28, 56

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Brer Rabbit - Indian Style

Almost everyone is familiar with the Uncle Remus stories, especially "Brer Rabbit and the Tar Baby." The pueblo Indians have a story with a jackrabbit as the hero which is almost exactly the same as Brer Rabbit until the ending. In the Indian version, Brer Fox is a farmer and the Tar Baby is a Piñon-Gum Baby. Uncle Remus ended his story with Brer Rabbit being thrown into the briar patch and escaping. In the pueblo story he is caught and made into soup with chili. The head of the household gives a warning that not a drop of the soup be spilled, but a drop is spilled, and the jackrabbit comes to life and runs away.

Sources: 28

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Roadrunner

The roadrunner is protected under Federal status and is the state bird of New Mexico. It is a large bird, up to twenty-two inches from tip of beak to tip of tail. Both the males and females have a mottled, black and white coloring.

This member of the cuckoo family is a ground bird. It can fly, but prefers to run. In most birds, a mother will simulate a broken wing to lure predators away from her chicks. However, when an intruder comes too near a roadrunner's nest, the mother will drop to the ground and pretend to have a broken leg, flapping wildly, but steadily moving away from the nest. If this does not work the first time, she will run back up and try again.

The roadrunner probably has more control over the crest and tail feathers than any other bird. On sunny days, it can be seen to spread its wings and raise the neck feathers to expose its back to the sun. The back is covered with coarse down instead of feathers. The foot-long tail is used as a brake, rudder, and counterbalance when running. To make a turn, it is swung at right angles to the body like a tiller. When stopping, it is fanned out perpendicular to his back for an "air brake." It can also be thrown over the back, almost touching the head, to counterbalance erratic movements.

Roadrunners prey on young birds, lizards, and snakes. Victims are shaken to death with the beak, then turned lengthwise to be swallowed. If the animal is too long (roadrunners have been known to kill and eat rattlesnakes twenty inches long), part of it will dangle out of the beak until the swallowed portion is digested, and the rest can be swallowed. A story in the West is that a roadrunner kills big snakes by building a fence of cholla joints around a sleeping snake. When the snake wakes up, he is so mad at being trapped he ties a knot in himself and chokes to death.

In the Southwest, the roadrunner is known as "El Paisano," meaning fellow countryman. It is believed to be good luck to have a roadrunner stay near the house.

The roadrunner is zygodactyl, two toes in front and two toes behind. This causes the tracks to form an "X," and it is hard to determine which direction it came or went. Pueblo Indians took advantage of this by inscribing roadrunner-like footprints on the ground near the home of a recently dead person. Thus, the evil spirits could not tell which way the soul of the dead had gone.

Sources: 11, 25, 30, 31

General Category: Wildlife

Subject: Western Diamondback Rattlesnake

Rattlesnakes belong to the snake family known as pit vipers. On each side of the head between the eye and nostril is a depression. This loreal pit is a temperature-sensitive organ used to sense the location of prey. The rattle, a series of interlocking, horny segments, is found on no other serpent. Rattlesnakes have the highest developed venom-injection system of any snakes. The large, hollow, movable fangs are located at the front of the upper jaw and may be up to an inch long. At rest, the fangs are folded back against the upper mouth. When striking, they are swung forward to pierce the victim's skin. The venom is then pumped through the fangs into the victim. The venom has a destructive effect on blood and a disintegrative effect on tissues.

The western diamondback rattlesnake is the largest western rattlesnake, reaching lengths of up to six feet, and weighing up to fifteen pounds. Four to five feet is the average length. The back is gray, brown, or pink with brown diamond -or hexagon -shaped markings. Smaller blotches are on the sides. All markings are sometimes indistinct and speckled with small, dark spots. A light-colored stripe extends from behind the eye to the upper lip in front of the corner of the mouth. The tail is set off from the rest of the body by black and white rings which give the snake the nickname of "coontail rattler."

This snake is perhaps the most dangerous snake in North America. It often holds its ground and defends itself aggressively when disturbed.

Contrary to popular belief, a rattlesnake does not have to coil to strike, and does not always rattle before striking. The average striking distance is one-third of the body length, but can be one-half of the body length. Another common misconception is the number of rattles indicate the age. A young snake may add three or four rattles a year; an old snake may add one or even none.

A rattlesnake diet primarily consists of lizards and rodents including ground squirrels, rats, mice, gophers, and rabbits.

Sources: 17, 54, 74, 75

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Horned Lizard

Horned lizards, or "horned toads" as they are more commonly known, can be found from Missouri to the Pacific coast, and from Canada into Mexico. Each of the seventeen species prefer dry, sterile habitats. Unlike most animals, horned lizards are most active during the hottest part of the day.

These lizards resemble toads with their wide, flat bodies. They are covered with fine, granular scales from which protrude scattered spines. Around the edge of their bodies are a fringe of spines. The largest spines are on the temples and the back of the head. On the chin, and parallel to the mouth, are a row of keen-edged and projecting plates.

Horned lizards are probably most unique in their methods of protection. The horns give some protection against smaller predators, but have little effect on larger enemies. Three adaptations the lizards possess to avoid detection are: 1) structural features which create a similarity to inanimate objects, 2) coloration which obscures the outline of the body or blends with or mimics some object, and 3) behavior that orients the body to give the first two adaptations greater effectiveness. Many times, horned lizards cannot be seen unless they move. If disturbed, they may flatten themselves until it seems they have no internal organs, may inflate themselves by gulping air, may try to jab with the horns, or may squirt blood from their eyes. This blood comes from a sinus at the base of the third eyelid. The blood is supposedly irritating to the eyes of predators, but the squirting does not harm the lizard.

Horned lizards feed on grasshoppers, crickets, roaches, and grubs, but seem to prefer black ants. They catch these insects just as frogs and toads do, by flicking out their sticky tongues.

To escape the chill of night, horned lizards burrow into the sand. The lizard imbeds its nose like the blade of a plow and makes a furrow a few inches long. Settling into the furrow, it uses the spines on the edge of its body as a shovel, digging deeper and tossing the sand over its back. It sometimes burrows two to three inches below the surface. At other times, it leaves its head level with the ground.

Sources: 17, 25, 74, 80, 81, 82

INTERPRETIVE RESOURCES INVENTORY

General Category: Wildlife

Subject: Stink Bug

The stink bug is a large, glossy black, wingless beetle which can be up to two inches in length. This beetle is not a destructive insect as it feeds mainly on decaying vegetable matter. It is usually present year-around, and is especially prominent during periods of heavy moisture which speeds up the decaying process.

The stink bug gets its nickname from its defense mechanism. Like the skunk, it protects itself with an offensive gas. When molested, it stands on its head and emits a fluid from the tip of its abdomen. This secretion is so potent there is only one known non-parasitic predator, the grasshopper mouse.

The scientific name of the stink bug is Eleodes armata. Other common names are circus beetle, Eleodes bug, and Pinacate beetle. Eleodes armata means an insect armed with an oily fluid. Circus beetle comes from its habit of standing on its head when disturbed.

Sources: 11, 17

INTERPRETIVE RESOURCES INVENTORY

General Category: Man and the Environment

Subject: Piñon-Juniper Manipulation

Through time, piñon-juniper communities become more and more dense. As this occurs, the understory species disappear because of their inability to compete for nutrients, moisture, and sunlight. Wildlife populations and domestic livestock which depend on the understory for food cannot be supported. The lack of vegetative cover gives rise to run-off and erosion during thunderstorms.

Manipulation converts dense stands of piñon-juniper to open communities of browse, grasses, and forbs. Probably the best method of manipulation is chaining. In this method, an anchor chain is dragged between two tractors and uproots the trees in its path. Chains which weight up to 110 pounds per foot and have links $3\frac{1}{2}$ inches in diameter are used. The uprooted trees can be windrowed and burned, however, the debris offer excellent cover for wildlife, help slow run-off during storms, and are a valuable source of firewood. After chaining, the area is seeded with a mixture of browse, grasses, and forbs.

Piñon-juniper manipulation can achieve the following multiple-use benefits:

1. Increased grazing capacities for domestic livestock.
2. Reduction of erosion and improved watershed conditions by changing canopy cover to ground cover and increasing litter.
3. Increased water yield.
4. Improved wildlife habitat by establishing a variety of plant species.

Sources: 33, 47, 55

INTERPRETIVE RESOURCES INVENTORY

General Category: Man and the Environment

Subject: Man's Uses of Piñon

At Santa Clara Pueblo, piñon is considered to be the oldest tree and piñon nuts the oldest food of the people. As legend has it, it was the result of going up on the western mesa and eating the fallen piñon nuts that the people "first knew north and west and south and east."

The scientific name of the most common piñon, Pinus edulis, literally means pine with the edible nut. The piñon ranks first among native nut trees which are not also under cultivation. The nut crop in the Southwest averages between one and two million pounds per year.

The Indians had many uses for the nuts. They were an important food source and were eaten raw or cooked. In some cases, the green cones would be gathered before birds and rodents could get to them. The cones would then be put in hot coals which would melt the resin holding the cones closed and the nuts would be released. Nuts could be ground into meal and used in gruel, cakes, to thicken soup, mixed with yucca pulp or other fruit pulp for a pudding, and mixed with cornmeal or sunflower seed meal.

The nuts are high in fat content (35.4% whole and 60.7% hulled) and average over 3,000 calories per pound. They are comparable in caloric value to almonds, brazil nuts, peanut butter, coconuts, and bacon. Because of this high fat content, some Apaches did not allow pregnant women to eat piñon nuts for fear the unborn baby would grow too fat and make delivery difficult. After the child was born, piñon gruel was considered to be a great baby food. The fat made the nut meal very greasy and it was sometimes used to grease shoes.

The Indians expected a bumper crop of nuts every seven years which would be followed by an epidemic of smallpox. This could be true as during the harvest there was an intermingling of various groups. This intermingling could have aided in the spread of infections.

Piñon nuts are considered a delicacy by many and have an oily-nutty taste. They are collected commercially and for family use. Commercially they are sold whole or hulled, and are used in candy making.

If piñon nuts are to be stored for long periods of time, they can be roasted to preserve them. Besides, some people prefer the taste of roasted nuts over raw nuts. They can be roasted in a slow oven, about 250 degrees, for one hour, stirring occasionally.

Piñon needles were used in basketry with small roots used to bind the needles together. The Zunis utilized the needles as a cure for syphilis. The patient chewed and swallowed the needles and drank a tea made from the twigs. He then drank cold water and ran until he sweated profusely. Syphilitic ulcers were scraped until they bled and powdered pitch was sprinkled on them to aid in healing.

Piñon resin, also called pitch or gum, was used as an adhesive in pottery and basket making and mending and also acted as waterproofing. Arrowheads were attached to shafts and turquoise was cemented in jewelry using pitch. Indian girls used it as a face cream to prevent sunburn, and it was heated and applied to the face to remove facial hair. Medicinally, gum was put on cuts and sores to protect them from air. Furthermore, pitch aided in the preparation of a black dye, and was used as a chewing gum.

Among the Hopis, members of a mourning family placed pitch on hot coals and smoked themselves and their clothes after a funeral. In December, gum was put on the forehead before going outside as a precaution against sorcery.

Piñon bark was a desired roofing material for the Indians. They also used the inner bark as an emergency food to prevent starvation. This was done usually in the early spring and the bark normally was peeled from the south side of the tree.

The piñon-juniper woodlands are usually classed as "non-commercial," which means they have little timber value. However, piñon wood is used for firewood, mine timbers, posts and poles, in the production of charcoal, and in the making of novelty items as it works nicely with hand tools and turns well.

Piñon is used traditionally in the Southwest as a Christmas tree and is increasingly being planted as an ornamental. The piñon has been designated the state tree of New Mexico.

Sources: 9, 8, 14, 22, 34, 35, 41

INTERPRETIVE RESOURCES INVENTORY

General Category: Man and the Environment

Subject: Man's Use of Juniper

As in piñon, man has utilized juniper for many uses.

Of the New Mexico junipers, only Rocky Mountain juniper and alligator juniper consistently grow large enough to have any commercial value for wood products. The heartwood of junipers is very resistant to rot and thus they have long been valued for posts and poles. The wood carves nicely and is used in making novelties. Other uses include cedar chests, closets, millwork, interior finish, pencils, water buckets, woodenware and firewood.

Junipers share the common name "cedar," which is used throughout the world to designate any wood that has the aromatic odor characteristic of the junipers. This fragrance is due to oily, fragrant extractives rich in cedrol and other essential oils. Eastern and southern juniper species have been exploited commercially for "cedarwood oil" used in perfumes, pharmaceuticals, polishes, and insecticides.

The Indians used the berries in the late summer or fall, and ate them raw or cooked. When used as a flavoring, they give a sage-like taste to food. Dried berries were ground into a meal to make mush or cakes. The berries were also roasted and ground to make a coffee-type liquid, and the berries and young shoots can be steeped for tea. Gin derives its flavor from juniper berries. The berries also have a thin coating of fragrant wax which can be removed by boiling, then skimming or evaporating the water.

The leaves were also used by the Indians to flavor food. The flavoring was prepared by burning the green leaves, pouring boiling water over the ashes, and straining the liquid. In Chihuahua, Mexico, the leaves are reported to be a local remedy for rheumatism and neuralgia. The leaf oils are diuretic, which sometimes causes problems for cattlemen whose livestock have grazed on junipers.

The inner bark can be eaten as an emergency food.

Junipers are being planted as ornamentals in landscaping.

Sources: 8, 14, 32, 35, 51

INTERPRETIVE RESOURCES INVENTORY

General Category: Man and the Environment

Subject: Yucca and Its Uses

The yuccas (*Yucca* spp.) are not cacti as many people think, but actually belong to the lily family. They are related to such plants as the lily and the onion.

Yucca, the state flower of New Mexico, is known by many names throughout the West, including datil, soapweed, and Spanish bayonet. Due to the wide range of the genus and its number of uses, yucca is considered by many to have been the most important of the plants used by the Indians in the Southwest.

As was typical of the Indians' frugality, all parts of the plant were used. The flowers, fruit, and the tender, central leaves were eaten. The large, fleshy fruits were eaten raw, baked, broiled, and ground into meal. The leaves were cooked in soups, boiled in meat, and fixed in other ways.

Besides being eaten, the leaves had a number of other uses. They were tied into bundles and used to make a primitive kind of broom. The leaves were also soaked in water until soft and then beaten with a wooden mallet to separate the fibers. The fibers were used to make cord, rope, sandals, baskets, matting, fabric, fishing and carrying nets, straps, cradle boards, brushes, dolls, and games. In addition, the leaves were used to make medicine, and the juice was used as a varnish for kachinas.

During World War I, the government took a hint from the Indians and used yucca fibers to make 80 million pounds of bagging and burlap. This was discontinued after the war, but was renewed for World War II. A factory was built at Kingman, Arizona to extract yucca fibers, but it failed.

Soap from the roots was used by the Indians to wash hair and clothes, and used ritually in many ceremonies. These rites included name-giving, adoption, weddings, puberty rites, and to purify warriors returning from battle.

Sources: 8, 24

INTERPRETIVE RESOURCES INVENTORY

General Category: History

Subject: Place Names

A place name is a word which identifies a geographic entity - a mountain, lake, river, town, or even a street. In New Mexico, place names are derived from six language divisions. Four of these are Indian: Tanoan, Keresan, Zuñi, and Athapascan. Spanish is the fifth language, and Anglo, including American and all European sources, is the sixth.

Most Indian names are descriptive or based on personal incidents. Nachiti, in McKinley County, is Navajo for "badger water" and may mean "scratching for water."

In addition to descriptive terms, the Spanish used names to commemorate persons, places, and events, especially those concerning religion. Magdalena is named for Mary Magdalene. A face and bust formed by rocks and shrubs on the north end of the mountain range is said to resemble her head. One story is that a band of Apaches had surrounded, and were about to overpower, a party of Mexicans when the face of Mary Magdalene appeared on the mountainside, frightening the Indians away. Many of the Spanish names which are descriptive are corruptions of Indian words. Pojoaque is the approximation of posoong wa ghay, Indian for "drink water place."

The Anglo terminology incorporates the Indian and Spanish patterns of naming, plus humor and irony and merging words or initials to form acronyms. A mesa north of Silver City is called Belly-Ache Mesa supposedly because a cook warmed over some soured frijoles and upset all the cowhands on a roundup. The pioneers could not seem to think of a name for a small creek near Taos, so it is called "Quien Sabe?" - "Who Knows?". Two examples of acronyms are: Stanolind, a former oil community southeast of Shiprock that got its name from the Standard Oil Company of Indiana; and Maljamar, named for the children of William Mitchell - Malcolm, Janet, and Margaret.

Sources: 86

INTERPRETIVE RESOURCES INVENTORY

General Category: History

Subject: Occupation of the Piñon-Juniper Type

The piñon-juniper woodlands have been occupied by the Indians, the Spanish, and by American settlers.

Studies have shown that many Indian habitations are in or near piñon-juniper forests. Apparently, these sites were chosen because of the agreeable local environment; abundance of wood for building, cooking, and heating; nuts and berries for food; plants and compounds for medicinal purposes; materials for ceremonies and rituals; and the favorable habitat for game including deer and turkey.

When the Spanish arrived, they imitated the Indians in the use of the piñon and junipers. In addition to using the trees for fuel and building material, they fenced their livestock with posts made from the trees. The piñon became a traditional Christmas tree and the foliage was used for decorations.

During the Westward Expansion, and as the populations increased, piñon and juniper was used for fuel and fencing. Charcoal from piñons was used extensively as smelter fuel for early mining operations in the Southwest.

Piñon and juniper are still used. The wood burns with a nice fragrance and is a favorite for fireplaces. In states with piñon-juniper woodlands, piñon takes about $\frac{1}{2}$ of the market as Christmas trees. A major use of these woodlands is livestock grazing. Piñon and juniper are also being planted more and more as ornamentals.

Sources: 14, 35, 41

F. BIBLIOGRAPHIES

Two bibliographies are included in this document. The first bibliography contains sources used in the interpretive resources inventory. Sources are included which were not used for the subjects in this document, but they contain information that may be helpful. The second bibliography includes references which might be useful in the design and implementation of an interpretive plan.

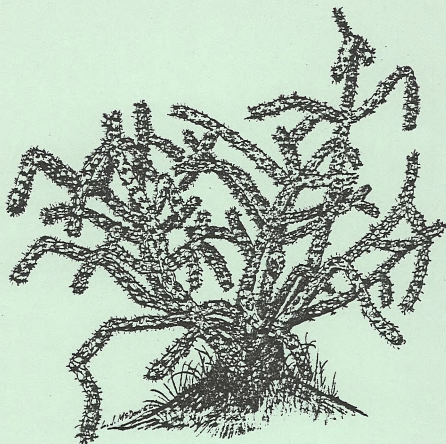
Each publication in both bibliographies is noted as to where it was found to give some idea of its availability. The abbreviations used in the notations are:

AL	Albuquerque Library, Main Branch
NM	New Mexico State Library - Santa Fe
SF	Santa Fe Public Library
NPS	National Park Service Southwest Regional Office
NMSO	BLM New Mexico State Office
DSC	Denver Federal Service Center

The numbers refer to the file code or the Dewey Decimal System classification.

The references which are considered to be most useful for obtaining interpretive information are marked with an asterisk.

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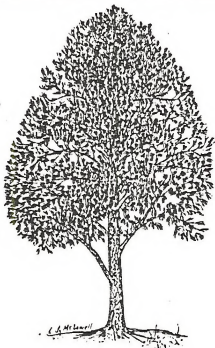
Pinus ponderosa

PONDEROSA PINE



Ponderosa pine covers the major expanse of New Mexico's forested mountains. This major lumber producer may grow to 180 feet in height and over 3 feet in diameter. A distinguishing characteristic of the species is bark that smells like vanilla.

Life zone: Transition



Pinus edulis

PIÑÓN PINE

Piñón pine is so common in New Mexico that it has been designated the state tree. It is typically found in the Upper Sonoran Life Zone growing in association with junipers. The tasty piñón nut is a favorite food for both humans and wildlife.

LICHENS

Lichens are actually two plants, algae and fungus, living together. The fungus obtains food from the algae and gives water in return. Living separately, algae and fungi are both typical of wet environments. In sharp contrast, lichens are more resistant to dry conditions than any other plants! Lichens are among the first plants to become established on bare rock. They start the soil building process that may eventually lead to a forest community such as you see here.

Life zone: All zones.

MOUNTAIN MAHOGANY

The generic name, *Cercocarpus*, means "tailed seed." The silky-haired plumes on the seeds can be up to 2½ inches long and make this plant easy to identify.

Mountain mahogany is valuable forage for deer and other wildlife. The "hedging" you see on this plant is evidence of heavy foraging by deer.

Life zone: Upper Sonoran and Transition

*Cercocarpus
montanus*





Agave parryi

CENTURY PLANT

The agave stores food until it is ready to bloom. The flower stalk may rise to 30 feet in height, growing as much as a foot per day. The plant may wait 75 years before blooming - hence the name "century plant". It flowers only once, then dies.



THE YUCCA AND



THE MOTH

Yuccas and a particular group of moths depend on each other for survival. The moths pollinate the yuccas while laying their eggs in the flowers. Thus, the yuccas can produce seeds, and the eggs can hatch. If the moths should ever fail to pollinate the yuccas, both will become extinct.

LIFE ZONES OF THE ORGAN MOUNTAINS

CANADIAN ZONE

Elevation: 8,000 ft. & above
 Rainfall: 12-20 inches per year
 Vegetation: Douglas-Fir, Aspen.
 Wildlife: Mountain Sheep,
 Long Tailed Weasel, Harlequin
 Quail, Dusk Shrew, Golden Eagle.

Organ Needle

TRANSITION ZONE

Elevation: 7,000-8,000 ft.
 Rainfall: 10-16 inches per year
 Vegetation: Ponderosa Pine, Gambel Oak,
 Mountain Mahogany, Satal.
 Wildlife: Mule Deer, Mountain Lion, Pinyan Jay,
 Red Squirrel, Horned Owl, Golden Eagle,
 Red-Tailed Hawk, Black Tailed Rattlesnake.

The Needles

Rabbit Ears

Primitive Camp

Baylor Pass

UPPER SONORAN

Elevation: 5,000-7,000 ft.
 Rainfall: 10-15 inches per year
 Vegetation: Mountain-Mahogany, Alligator Juniper, Gambel Oak.
 Wildlife: Antelope, Desert Bighorn Sheep, Pinyan Jay, Mule Deer,
 Golden Eagle, Red-Tailed-Hawk, Swainson's Hawk, Black Tailed Rattlesnake.

Pine Tree Trail

Baylor Post Trail

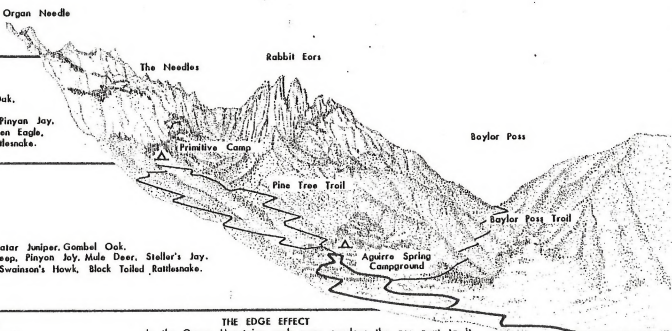
Aguirre Spring
 Campground

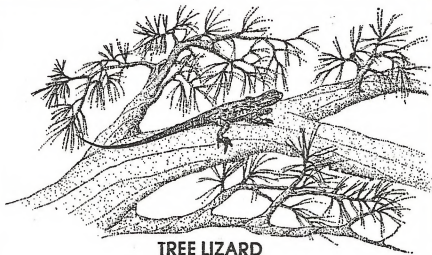
LOWER SONORAN ZONE

Elevation: 3,500-5,000 ft.
 Rainfall: 7-10 inches per year
 Vegetation: Creosote Bush, Mesquite, Grama Grass,
 Sagebrush, Yucca, Torrey Yucca.
 Wildlife: Gambel's Quail, Red-Tailed Hawk, Swainson's
 Hawk, Roadrunner, Jack Rabbits, Desert Mule Deer,
 Tree Lizard, Collared Lizard.

THE EDGE EFFECT

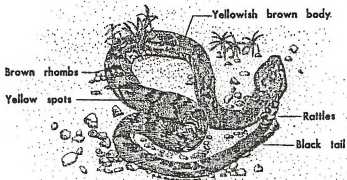
In the Organ Mountains each zone overlaps the one next to it. This is called the "edge" effect. At the edge of two adjacent life zones plant and animal species of both zones may be found living together. This effect is more pronounced here because of the rapid rise in elevation. Many species of wildlife may be found in all four life zones depending on the season and time of day.





TREE LIZARD
(Urosaurus ornatus)

Watch for the common tree lizard sunning itself on rocks or limbs. Look close because its tan or gray color makes it hard to spot. These lizards eat a wide variety of insects and are in turn preyed upon by roadrunners, snakes and the Collared Lizard.



BLACKTAILED RATTLESNAKE
(Crotalus molossus)

This common dweller of rocky places is both a threat and helper to man. He feeds on small rodents and helps keep their numbers in check. However, his venomous bite can also be fatal to man. He is active both day and night but is not aggressive. For his safety and yours, wear boots and stay on the trail.

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