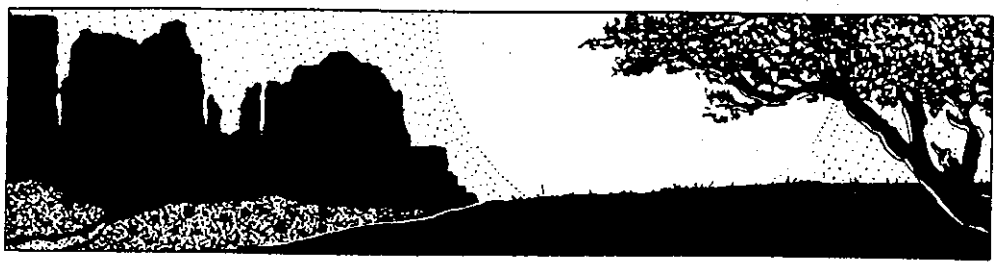
Sedona / Oak Creek Ecosystem



Characteristics and Condition:

Executive Summary and Supplemental Information

January, 1996

Sedona Ranger District, Coconino National Forest

National Forest Information Alert - *"The Redrock Ecosystem"*

Dear Community Member, January 30, 1996

I am pleased to provide you with this report about the redrock ecosystem. It has two parts: an Executive Summary, and Supplemental Information. Section II gives additional information to the highlights found in the Summary. This report is based on information gathered and evaluated from Forest Service public participation activities, surveys and research during the last few years.

This report describes the characteristics, conditions, and implications for planning of the six focus areas that we believe are most influential in understanding and caring for the redrock ecosystem:

ECOSYSTEM SUSTAINABILITY
ARCHEOLOGY AND HISTORIC SITES
WILDERNESS
RECREATION
COMMERCIAL USE
COMMUNITY RELATIONSHIPS

This is an interim report prepared for two purposes: for use with the 1996 Sedona Forum discussions about tourism management in the Sedona area and to share important information with residents, visitors and other agencies concerned about conditions of Forest lands in the Sedona area. A more complete ecosystem assessment report will be available in March. As many of you are aware, the Coconino National Forest is revising managment direction for the Sedona Ranger District. This resource information provides a foundation for creation of a draft plan for the District in 1996.

Clearly, the report that follows is not exhaustive. As you read through it you will likely think of other things and have questions. We hope you will draw your own conclusions. I would like to hear your thoughts concerning our focus areas and the information that we have presented.

So, find a comfortable place to read, and let us describe for you the key things that we believe are critical to know about the Redrock Ecosystem -- the primary and unique characteristics and their conditions. As you read, I hope you will learn more about the dynamics and challenges of this magnificent landscape.

If you have questions or comments, please feel free to get in touch. You may reach Jennifer Burns, the project leader for this effort, or me by phone at 520-282-4119.

Sincerely,

Ken Anderson

KEN ANDERSON
District Ranger

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INTRODUCTION

This report describes the characteristics and condition of six key aspects of the Sedona/Oak Creek Ecosystem Planning area:

- Ecosystem Sustainability
- Archeological and Historical Sites
- Recreation
- Wilderness
- Commercial Use
- Community Relationships.

Based on the best information gathered to date, we've focused on these six areas in order to address the most pressing concerns first. Through our resource investigations we are trying to understand the most critical and important characteristics of these resources and their current conditions, those which will influence the need for changes in forest management.

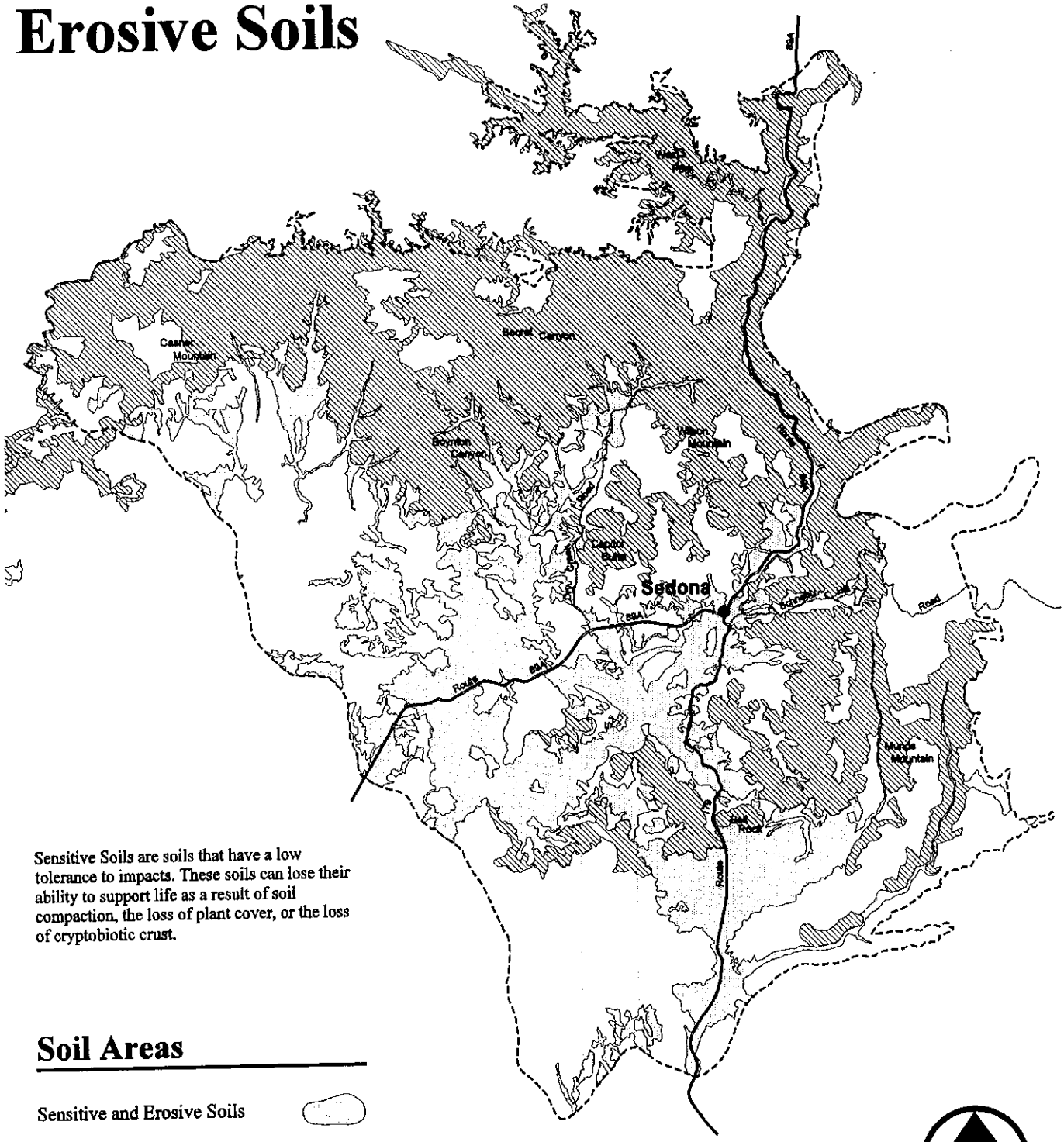
A final resource assessment will be available in February, 1996, and will contain more expansive information, while this report captures the essential nature and importance of those details.

Section I provides an executive summary. Section II provides supplemental information to give a context to the highlights found in the summary.

Areas of Sensitive and Erosive Soils

Sedona · Oak Creek Canyon Ecosystem Management Plan

Coconino National Forest · Sedona Ranger District



Sensitive Soils are soils that have a low tolerance to impacts. These soils can lose their ability to support life as a result of soil compaction, the loss of plant cover, or the loss of cryptobiotic crust.

Soil Areas

Sensitive and Erosive Soils

Steep Cliffs and Slopes

Study Area Boundary

State Highway

Unpaved Local Road

NORTH

Scale:

0 1 2 3 4 5 Miles

SECTION I: EXECUTIVE SUMMARY

Ecosystem Sustainability

Special natural characteristics in the Sedona area include sensitive soils; an extraordinary diversity of plants and animals, including many rare species; the very lush and complex environment of the Oak Creek stream corridor; and the dynamic environmental influences of fire and floods.

Sensitive Soils in Many Places:

Much of the planning area has highly sensitive soils that coincide with places in demand for urban and recreational development. Soils classified as highly sensitive to erosion cover about a third of the accessible land in this area. Much of this highly erosive land is near Sedona. This condition limits the activities that can occur without causing long-term erosion problems, or without requiring well planned erosion-control measures. Similarly, soils in the riparian zone along Oak Creek are sensitive to compaction and erosion. Loss of streamside plants from development and trampling can weaken soil stability and leave streambanks vulnerable to damage from flood flows. Refer to Figure 1: Areas of Sensitive and Erosive Soils.

High Biodiversity and Rare Plants and Animals:

The planning area has exceptional biological diversity and healthy populations of many rare species, especially along the Oak Creek riparian corridor. Variations of sunlight, elevation, aridity, and soil composition result in an unusually diverse ecosystem. These variations have produced a complex mosaic of intermingling plant and animal microhabitats, uniquely set next to one another. Some of the features of this complex ecosystem include a stable population of pronghorn antelope, several key wintering areas for elk, and one of the highest concentrations of peregrine falcons eyries in the Southwest. Refer to figure 2: Important Habitat Areas.

Many rare plant and animal species reach their geographic limits within the planning area. The area also contains species of animals and plants that have a wide but clumpy distribution. Some of these rare species—such as the gila woodpecker, the yellow warbler and the peregrine falcon—have healthy populations in the planning area, although elsewhere their populations are declining.

Of the five fishes native to Oak Creek, one, the Gila trout, is federally listed as an Endangered species, and the others are candidates for listing. Oak Creek has healthy populations of two of these fishes, and can play an important role in the the protection and recovery of all of them. Only the Gila trout has completely disappeared from Oak Creek. Protection and recovery depend in part on our management of aquatic habitat and non-native fishes (which are annually stocked in Oak Creek).

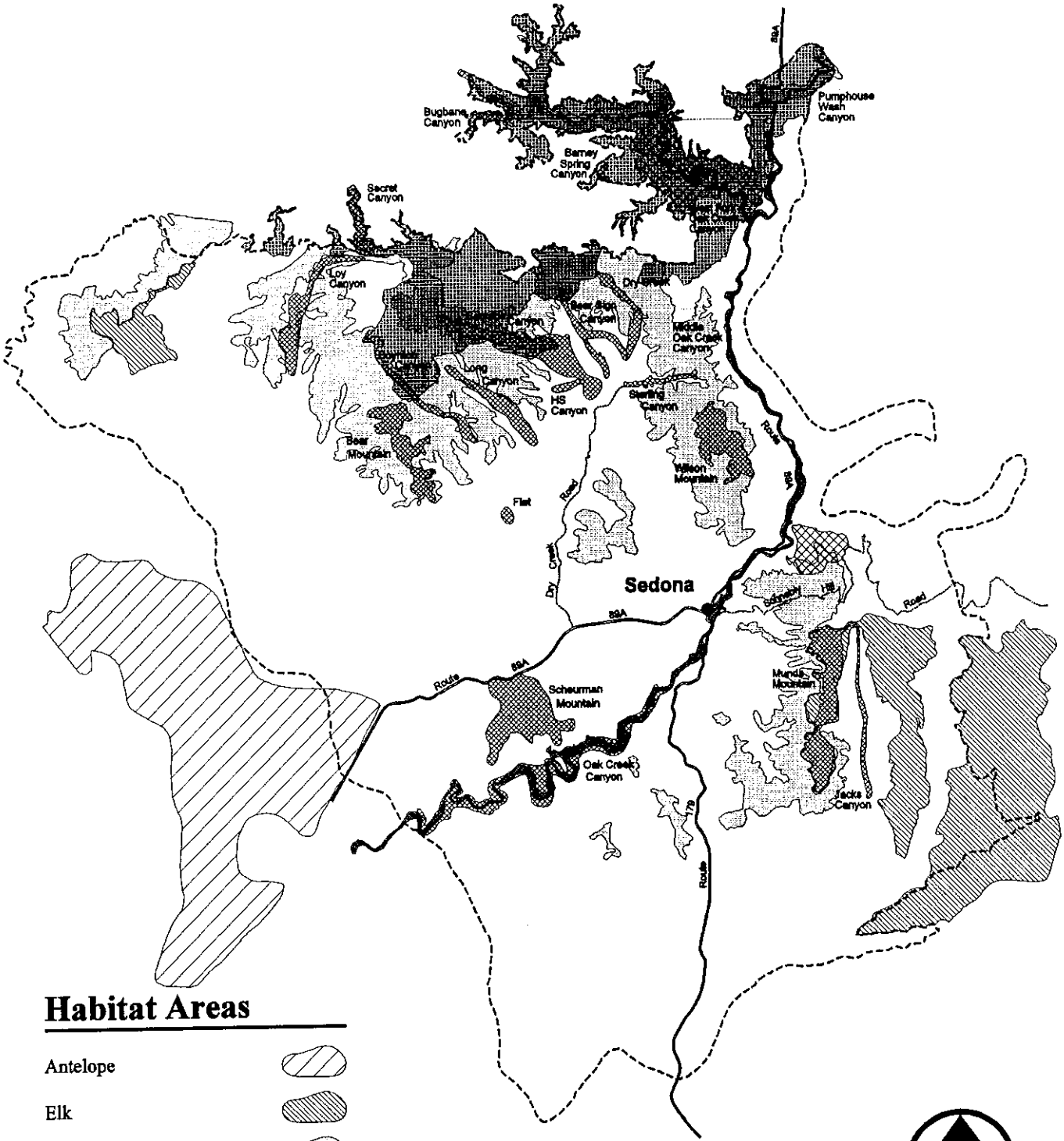
This complex and rich biodiversity presents both opportunities and complications for people. Many people visit or live in the Sedona area to experience its natural diversity. Facilities and infrastructure and the locations of certain activities must be carefully designed and planned to minimize effects on this complex ecosystem.

Executive Summary - Figure 2

Important Habitat Areas

Sedona · Oak Creek Canyon Ecosystem Management Plan

Coconino National Forest · Sedona Ranger District



Habitat Areas

- Antelope
- Elk
- Peregrine Falcon
- Mexican Spotted Owl
- Riparian Habitat
- Area of Botanical Interest
- Research Natural Area

- Study Area Boundary
- State Highway
- Unpaved Local Road

Scale: 0 1 2 3 4 5 Miles

Exceptional Riparian Habitat Along Oak Creek:

Oak Creek not only provides one of the most significant biological corridors linking the Mogollon Rim to the Verde River, but it also serves as the most developed and popular tributary to the Verde River. This concentrated and complex mixture of biological and social uses of Oak Creek and the West Fork of Oak Creek influences the health of rare plants, fragile streamside plant communities, and water quality.

Parking and recreational activities affect important plant "filter" strips along the streambanks. Impairment of riparian filter strips may also weaken the ability of streambanks to resist flood flows. In some locations, this has degraded aquatic conditions for fish and other riparian and aquatic dwellers and has created undesirable recreation conditions.

Water quality is important to both the biological sustainability and the recreational appeal of Oak Creek. Although the natural system has adapted to large natural fluctuations of turbidity and flow, high bacterial levels often diminish Oak Creek's water quality and create unsafe swimming conditions.

Fire and Flood:

Fire and flood are the two most influential ecological processes in the planning area. While human developments seem to have had little influence on the frequency or intensity of floods, the suppression of natural fire has profoundly affected the ecosystem.

Plant communities that had adapted to periodic fires have been replaced by less fire resistant plants. A fire under these new conditions would be more intense and damaging than naturally occurring fire. Because of fire suppression, many areas that were once open savannah have grown in with pinyon-juniper forests, reducing the amount of habitat for certain animals, such as the pronghorn antelope, which rely on open grasslands.

Streamside plant communities have also adapted to regular flooding, relying on the new soil deposits and clearing that floods cause. Any alteration of the periodic flood disturbance patterns in Oak Creek would profoundly change its ecology. Facilities in the floodplain that require flood control as part of their maintenance would alter this dynamic pattern.

Archeological And Historic Sites

Archeological and historic sites in the Sedona area have significant scientific and aesthetic value and are especially important to American Indians. Some sites provide a record of human occupation of the Verde Valley going back nearly 8,000 years. Despite their world-class importance, high visitor use and lack of protection threatens these sites.

World-Class, Little-Studied Archeology:

The exceptional quality of the rock art, the density of sites, and the unique culture represented in the ruins make the archaeology of the Sedona area world-class. This resource is a major attraction for tourists to the Sedona area including many with new age philosophies who find spiritual significance at these sites. The many sites provide the equivalent of a vast museum, except that the sites are almost totally unprotected and unstudied.

High Visitor Use:

Recreational visits concentrate at a few archeological and historic sites, with thousands of people estimated to visit particular sites each year. Despite this heavy use, visitors find little guidance in the form of interpretive information, well-marked trails, or other facilities to accommodate the demand for experiencing these sites. Site damage levels are high and increasing. At best, lack of information on proper etiquette, and lack of directions leads to unintentional damage. At worst, vandalism destroys priceless art, scientific records, and cultural heritage.

The current rate of deterioration assures that archaeological value and the quality of visitor experience will continue to diminish. With only a small percentage of sites recorded, and none completely researched, damage results in irrevocable losses. Unless protected, many sites and the research opportunities they represent will be lost.

Significant Cultural Heritage for American Indians:

The heritage resources of this area are extremely significant to several American Indian Tribes in Arizona. The deteriorating condition of these sites has attracted a high level of interest from tribes, including the Prescott Yavapai, the Yavapai-Tonto Apache, the Hopi and the Navajo. They consider the area a critical repository of their cultural heritage, their "library", and, in some cases, the source of their tribal origin. This significance cannot be overstated.

Because of the Federal legal protection and special significance of traditional cultural properties important to contemporary American Indian groups, people and management plans must be particularly sensitive to the potential effects of recreation and other activities.

Recreation

Recreational attractions in Sedona draw visitors from across the United States and from around the world. Altogether, Sedona and Oak Creek Canyon attract more tourists per year than nearby Grand Canyon National Park. Visitation is steadily increasing and demographic surveys indicate an older, more urban audience with less free time. High visitor use in several key locations has increased the "wear and tear" on the environment. In addition, this heavy use diminishes the very qualities that draw people to the area.

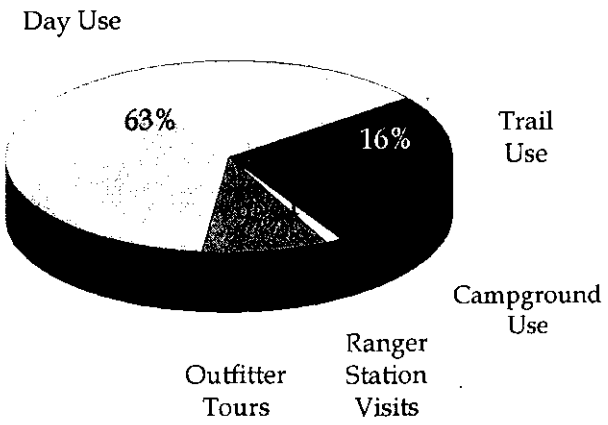
High Visitor Use:

Trends show increasing use of developed recreation facilities. In the Sedona area in 1995, more than a million people visited developed Forest sites such as campgrounds, picnic areas and swimming sites: an increase of 48 percent since 1974. The design and number of some existing facilities is inadequate to accommodate this growing use, especially in the most popular area, Oak Creek Canyon, where little room for expansion of facilities exists. Refer to Figure 3: Developed Site Use.

Figure 3

Visitors Served, Sedona Ranger District - 1995

Location	Visitors
Picnic, Swim, Vista Sites	893,864
Trails	224,044
Campgrounds	159,858
Commercial Outfitter Tours	132,786
Ranger Station	13,000
Total	**1,423,552**



DiverseVisitors, Diverse Reasons to Visit:

Character of and demand for recreation use has changed dramatically since 1974, with visitors now older, less physically mobile and more urban. Also, people have less time to spend and so tend toward day-use or short weekend stays. Surveys show that most visitors to Forest recreation sites in the Sedona area participate in more "passive" outdoor activities such as viewing and photographing scenery, automobile touring, walking, contemplation, and nature study. In contrast, some observations suggest that more active pursuits such as driving off-highway vehicles and riding mountain bikes are increasing in the Sedona area. Refer to Figure 4: Recreation Use Overview.

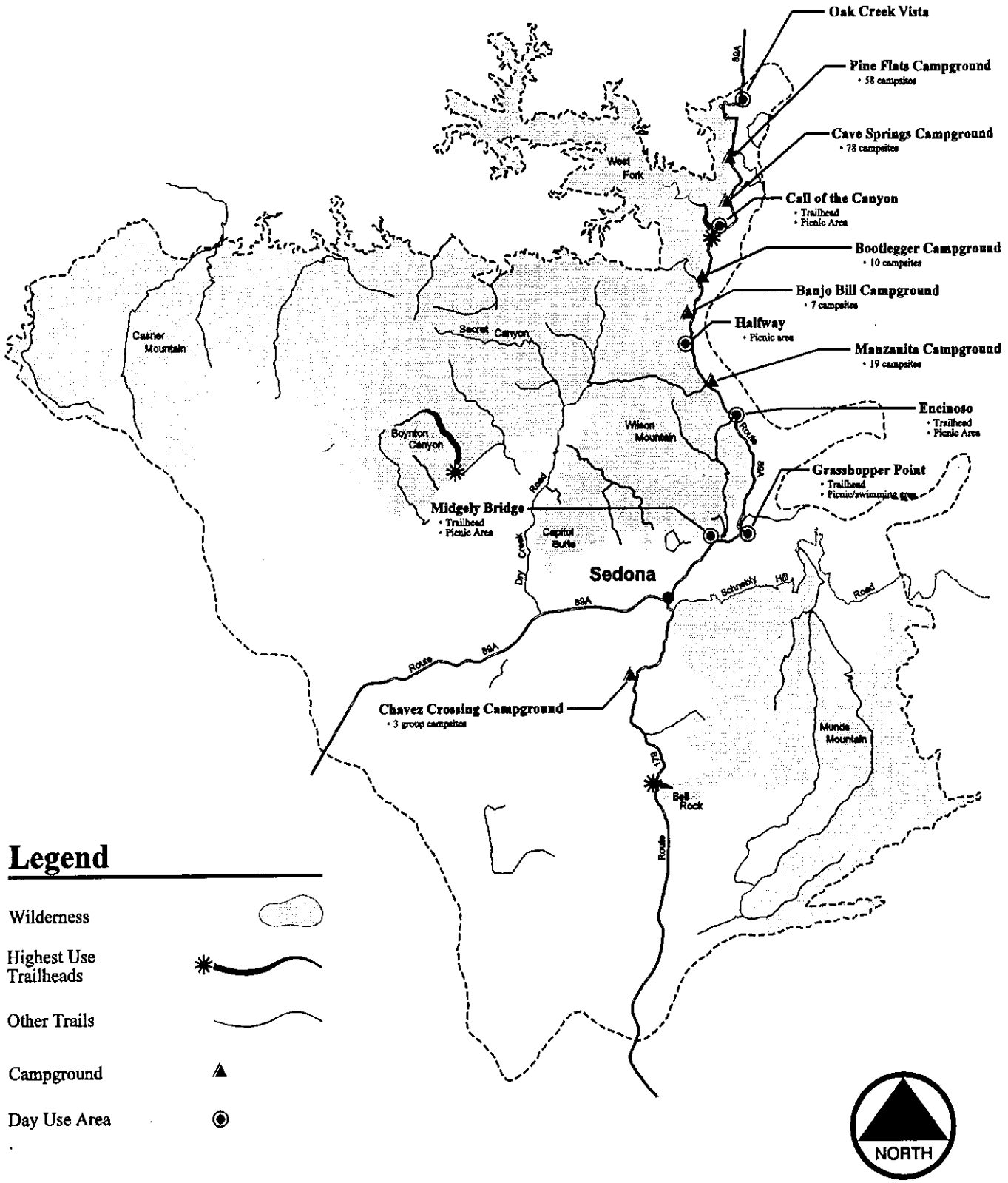
An increase in Spanish-speaking visitors calls for improved communications skills within the Forest Service to better provide information. The cultural diversity of visitors places other demands on facilities. For instance, campsites built with small families in mind now must meet expectations of larger extended families and multi-family groups.

The definition of recreational use has also broadened to include fulfillment of spiritual searches, as Sedona has become a Mecca for

Recreation Use Overview

Sedona • Oak Creek Canyon Ecosystem Management Plan

Coconino National Forest • Sedona Ranger District



Legend

- Wilderness
- Highest Use Trailheads
- Other Trails
- Campground
- Day Use Area
- Study Area Boundary
- State Highway
- Unpaved Local Road

people seeking inspiration and contemplation in nature. Numerous Forest sites are visited by large numbers of people predominantly for this reason.

Recreation Concentrated in Sensitive Areas:

Recreation developments are concentrated along Highway 89A in Oak Creek Canyon, one of the most significant biological environments of the planning area. An estimated 6 million people in more than 2.4 million cars traveled through Oak Creek Canyon in 1995. A 1977 study showed that 72% of these travelers are recreationists.

The physical effects of developed and dispersed recreation use are varied and growing. Impacts such as damaged soils and denuded plant communities occur as a result of driving off roads, parking outside designated spots, and hiking off defined trails. Similar effects occur in areas of frequent dispersed camping. Surveys conducted in 1995 show that more than 2,400 acres of the planning area have been altered. Heavy use of the most popular swimming areas contributes to water quality problems in Oak Creek. Not only does high visitor use contribute to the declining water quality through increased sediment disturbance, automobile discharges, and destruction of plant material, but also through fecal contamination, paper and plastic litter, and other material left behind. Trampling leads to widespread loss of the cryptobiotic soils (soils covered by a living crust made up of algae, fungi and bacteria, which helps prevent erosion and absorb water), which can lead to soil erosion. Aircraft overflights risk disturbing wildlife, as well as diminishing wilderness experience, and in some cases, damaging archaeological sites.

Demand for camping and picnicking is not currently being met in many locations, especially along Oak Creek. Crowding and lack of facilities in some locations is affecting the quality of people's recreation experience. Conflicts between different recreation activities as well as conflicts between recreation and sensitive resources exist and are growing.

Wilderness

More than 30 percent of the planning area is within Congressionally designated Wilderness areas. This includes the Red Rock-Secret Mountain Wilderness, the Munds Mountain Wilderness, and the Sycamore Canyon Wilderness. These areas have outstanding scenery, geology, biological diversity, and opportunities for solitude and primitive recreation. Legislation mandates protection of these resources. Mandated opportunities for natural quiet and solitude directly depend on wilderness qualities that are dramatically affected by the high number of visitors and by the proximity of these Wilderness areas to urban development, especially where residential areas and major highway corridors abut Wilderness area boundaries.

High Visitor Use, Short-Term Use:

These Wilderness areas are the most visited Wilderness areas in Arizona, with nearly a quarter of a million people stopping each year. Most of the visitors come from outside of Arizona. Refer to Figure 5: Wilderness Trail Use.

These Wilderness areas are used almost exclusively by day users, who stay less than half a day. More than half of the visitor use of these Wilderness areas concentrates in only three locations: West Fork of Oak Creek, Boynton Canyon and Bell Rock. Preliminary information indicates that although concentrated use at these places diminishes the opportunity for solitude and quiet, expectations are well met for most people.

Changes to Wilderness Character:

Certain human activities have profoundly affected wilderness character, such as the proliferation of unofficial, unmaintained trails, the development of land adjacent to Wilderness, and the increase in aircraft overflights. Moreover, fire management has reduced the occurrence of natural fire in the Wilderness, changing fuel conditions and plant community patterns and structure.

Falling Short of Wilderness Goals:

The exceptional natural qualities of these rugged Wilderness areas are well suited to provide primitive recreation, quiet, and solitude. However, the proximity of these Wilderness areas to urban developments, roads, and high use recreation facilities, and the current patterns of recreational use present significant challenges to carrying out the intent of the Wilderness Act.

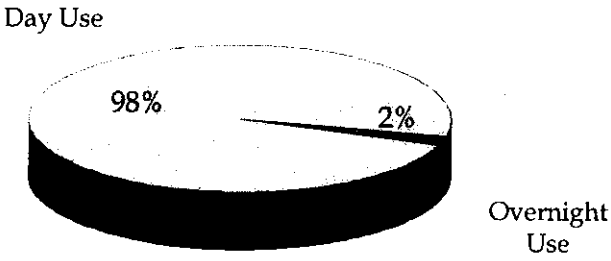
Figure 5

Wilderness Trail Use - 1995

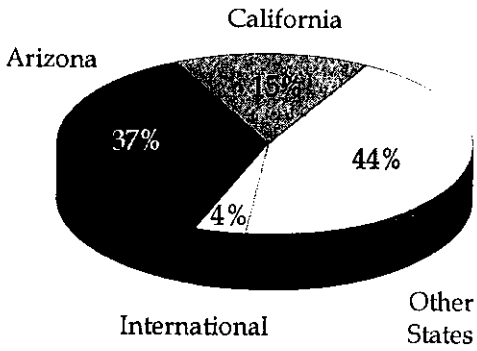
Compiled from trail counters and trail registration boxes

Character of Use

Wilderness	Day	Overnight	Total
Red Rock / Secret Mtn.	185,500	2,812	188,312
Munds Mountain	29,884	69	29,953
Sycamore Canyon	4,249	1,529	5,779
Total	**219,633**	**4,410**	**224,044**

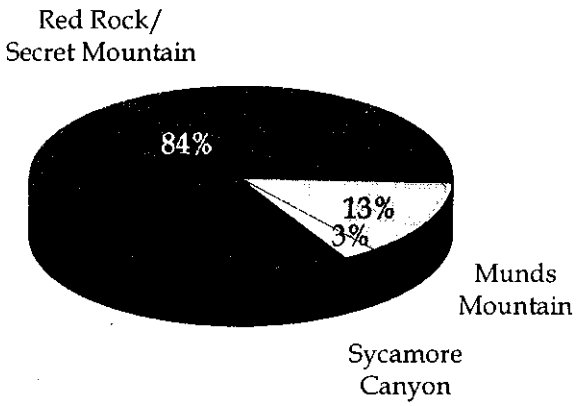


Origin of Trail Users



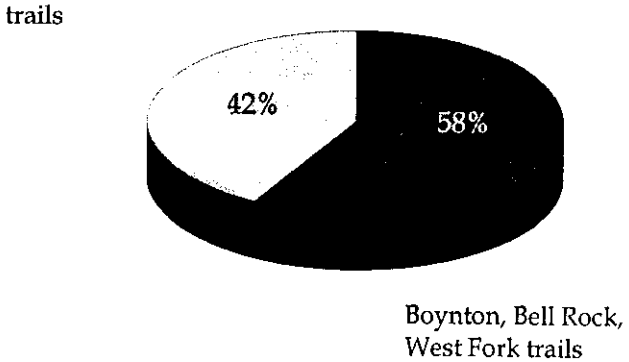
Use Levels by Wilderness Area

Wilderness	Users/Year	Percent
Red Rock / Secret Mtn.	188,312	84%
Munds Mountain	29,953	13%
Sycamore Canyon	5,779	3%



Most Popular Trails

Wilderness Trail	Number of Users
Boynton, Bell Rock, West Fork	129,993
All other Wilderness trails	94,051
Total Wilderness trail use	**224,044**



Commercial Use

The tourism industry in Sedona/Oak Creek depends heavily upon the surrounding National Forest for support. Many of the sights to see are located on public lands. The Forest Service allows commercial uses on National Forest lands to enhance recreation opportunities and to promote appropriate resource use. Commercial outfitter/guide services can help meet both visitor and Forest Service needs. At the same time they can contribute to "wear and tear" on the environment and affect other National Forest activities.

Increasing Demand for Commercial Guided Ecotourism:

Tourist outfitter-guides provide one of the most popular commercial uses of the Sedona District: they served more than 130,000 visitors to the Forest and generated over $5 million in gross revenue in 1995. Revenue generated by ecotourism on the Sedona District has increased at more than 10 percent each year since 1991. None of this revenue goes directly back to Sedona area Forest management. Many tourists benefit from the interpretive services provided by commercial guides, who meet the needs of people unequipped or unwilling to travel Sedona's back country on their own.

Strong Demand for Commercial Filming:

An increasing number of commercial filmers use this landscape as a backdrop. Sedona Chamber of Commerce records show that from July 1993 to June 1994 the filming industry contributed $2,757,000 to the local economy through goods, services and payroll. Many of the sites in demand by filming crews are also locations most popular with tourists including Slide Rock, Cathedral Rock, Schnebly Hill, Broken Arrow and Dry Creek Road.

New Approaches Needed to Meet Demand and Prevent Impacts:

Although permit administration helps to control the amount of environmental impact caused by these services, commercial use could damage soils, plants, and cultural resources; disrupt wildlife; and increase conflicts with other users. Commercial permittees generally prefer many of the same Forest locations that tourists and many residents visit. This can cause conflicts and additional resource effects. Ultimately, the environmental effects of commercial activities are difficult to distinguish from the effects of other users. In addition, the relationship between commercial outfitter-guide activities and the quality of the experience of other visitors remains unclear.

Community Relationships

A complex relationship exists between the community of Sedona and surrounding National Forest lands. The community depends on the National Forest for economic, infrastructure, aesthetic and recreational benefits to residents, yet community growth can affect the attributes that draw people to live here, including the scenic values, heritage resources, and biological communities. Also, developments that occur close to National Forest lands can be threatened by natural processes such as fire. The location of development can also complicate fire management on National Forest lands.

High Value of the National Forest to Locals:

Sedona residents value the National Forest landscape and wish to preserve the natural surroundings. Resident surveys and comments indicate that National Forest lands provide significant benefits to residents, such as open space, recreation opportunities and scenery. Indications are that new residents are unfamiliar with the unique and sensitive environment, yet a large portion of the residents show concern about protection of the area.

In addition, many residents are concerned about the growth in the Sedona area. The community is divided by those who want development and those who want to limit development. Many residents would like to retain National Forest lands for open space and recreational values and limit any additional growth to the existing private land base.

Increasing Risk of Fire as Development Moves to Outlying Areas:

Potential for wildfires to threaten people and property increases as more people build homes in the pinyon-juniper forest surrounding Sedona. These areas become more difficult to defend because of the build up of fuels on the ground.

Increasing Demand for Infrastructure on National Forest land:

Sedona is essentially "land-locked" by National Forest land, limiting additional land available for development. Most residents expect basic urban infrastructure such as phone, gas, power, sewer, paved roads, etc. These developments often change the valued natural setting. Because of the demand for new community infrastructure, the Forest Service is currently involved in approximately six major road and utility corridor studies for projects that would affect Forest lands around Sedona. Many other smaller scale projects are also pending.

Ecological Impact Correlates with Rapid Development:

As more residential development occurs on the boundary between Forest and town, and as tourist visitation increases, concern is growing about how to manage the urban/Forest interface. National Forest lands adjacent to some residential areas are impacted by off-road-vehicles, trash dumping, and numerous informal pathways. Many previously undeveloped private parcels once gave people informal access to the Forest. As these parcels develop, residents find themselves unwillingly playing host to visitors trying to access the National Forest. Moreover, as expectations for community services increase in outlying areas—and facilities such as roads and utility corridors appear–impacts to adjacent wildlands increase. For example, development of outlying parcels threatens to fragment important pronghorn antelope habitats.

SECTION II: SUPPLEMENTAL INFORMATION

This section provides more detailed resource information to support the main points in Section I.

Ecosystem Sustainability

Sensitive soils in Many Places:

Several rock formations in the planning area resist erosion, forming cliffs and other inaccessible land forms that provide little opportunity for human development. These include the Esplanade Sandstone, the Schnebly Hill Formation, and the Coconino Sandstone, comprising approximately 31 percent of the planning area. In general, trails and roads constructed on them are very stable.

In contrast, the more accessible flatter lands tend to be underlaid by softer, less stable Rock formations, such as the Hermit Formation and the Verde Formation. Most of the human development within the Sedona/Oak Creek planning area, including most roads and trails, rests on ground underlaid by the Hermit Formation. Because rocks in this formation are moderately erosive, more moderate slopes form from them.

- The Hermit Formation lies beneath many of the low hills around and to the south of Sedona. The Hermit Formation includes a mixture of hard and soft beds, which means erosion potential will vary markedly from site to site. This characteristic and the predominance of sensitive soils produced from this rock means that care needs to be taken in developing areas underlaid by the Hermit Formation.
- The Verde Formation lies in the southern part of the planning area. Rocks of this formation tend to be highly erosive in certain localities, but more resistant where limestone and volcanic rocks predominate.

Other flatter, more accessible lands contain extensive terrace gravels of recent times. They are highly erosive and produce sensitive courser soils. Deposits of recent stream activity lie along channels of established drainages in the Sedona/Red Rock planning area. The most extensive deposits are located along lower Oak Creek and Dry Creek.

Whenever considering development that rests on these formations, well planned placement and design of facilities becomes critical, and may involve higher costs necessary to control erosion.

The Sedona area supports cryptobiotic soils, communities of blue green algae, lichens and fungi that form a thin crust on sandy soils. This fragile crust protects the soil beneath from erosion, absorbs water, and starts a chain of life. Heavy foot and vehicle traffic in many areas around Sedona has removed this surface crust and exposed the underlying soils to erosion. Once affected, this cryptobiotic layer can take more than a decade to reestablish.

Controlling erosion is important from the standpoint of protecting many resources. Not only are facilities such as roads at risk during high- runoff periods, but unseasonable erosion that occurs as a result of recreational use or development activities can muddy Oak Creek during times of the year when it would naturally run clear, affecting the life cycle of aquatic animals.

Although streamsides serve as a focal point for campgrounds and picnic areas on the Sedona District, their unconsolidated properties and tendencies to be wet makes them easily eroded or compacted.

These are some of the most sensitive soils in the Verde River watershed. Human activities can break down the stream banks as well as compact the wet soils. This can result in loss of the protective plant cover, causing impacts to the riparian functions. Functions that are affected include the riparian area's ability to serve as a filter strip for overland runoff during storms, and the ability of the riparian area to support wildlife, including aquatic animal and plant life.

High Biodiversity and Rare Plants and Animals:

The ecological variability of the Sedona/Oak Creek vicinity results from the many environmental elements: high cliffs and flat plains, rocky slopes and valleys with deep soils, moist canyons and dry grasslands. The extraordinary variety of vegetation, soil and climactic conditions within the planning area provides an equally extraordinary number of habitats. For instance, about 32 species of ferns can be found in the Red Rock-Secret Mountain Wilderness. Three species reach the northern limit of their range here; at least three others reach the southern limit of their range. A very high density of plant species also thrives along the Mogollon Rim, where the Ponderosa pine forest gives way to a chapparral plant community. This area is also important winter habitat for elk and deer.

Flagstaff pennyroyal

The rims that overlook Oak Creek provide habitat for one of the populations of this Forest Service Sensitive Plan. The proposal to list this as a Threatened species (because development in the Flagstaff area threatened its habitat) was deferred when the Oak Creek population was found in 1984 during a survey conducted specifically to locate outlying populations.

Flagstaff pennyroyal typically grows in open areas on the dolomitic limestone rock faces of the Kaibab Formation. Prescribed fire studies have demonstrated that pine needle accumulation can inhibit or deter the species from establishing. Evidence suggests that natural fire once served to open habitat for these plants and improve plant reproduction success.

Arizona cypress

The Casner Canyon Research Natural Area was set aside specifically to protect this tree species. Arizona cypress occurs abundantly along an 80 mile stretch of the Verde River, including its tributaries such as Oak Creek, at elevations between 4,000 and 5,000 feet.

Bats

Twelve species of sensitive bats may occur within the planning area. Documentation exists for numerous occupied roosts (hibernacula, day roosts, and night roosts) located in sinkholes, buildings, and under bridges, with snags providing other potential sites. Smoke from campfires in Oak Creek can reduce insect populations that bats feed on in the canyon.

Peregrine Falcon

The cliffs around Sedona provide habitat for the American peregrine falcon, a species listed as threatened under the Endangered Species Act. We know of nine peregrine eyries in the planning area, one of the highest densities of nesting peregrines in the Southwest. The high density of nests attests to the large amount of suitable habitat located along the red rock cliffs. Human activity has the potential to disturb the reproductive cycle of the birds, especially when sight-seeing trips intrude on the nest ledges (example: helicopters hovering close to get views.)

Antelope

The grasslands within the planning area grow in relatively deep, limestone-based soils that support dozens of species of grass. The grasses provide habitat for pronghorn antelope that range from within the planning area to adjacent grasslands. This population has maintained itself at about 30 head for the last 20 years.

Three factors influence the pronghorn antelope population dynamics: habitat fragmentation, cattle grazing and pinyon/juniper invasion. Fragmentation of habitat has accelerated as private lands are developed in outlying areas. With improved roads and more human activities in the grasslands, the antelope have a more difficult route when moving about their natural range. Compounding this trend, grazing has prevented grasses from growing tall enough to provide hiding cover for young antelope, thus increasing the risk of coyote predation. Preferring more open grasslands, the antelope avoid denser stands of pinyon-juniper woodlands. These woodland areas have enlarged as fire suppression efforts have allowed trees to grow into the grassy areas.

Elk

Areas along the Red Rock rim provide year-round habitat for elk. During the winter, these areas experience extremely high levels of use as they are browsed by resident herds as well as wintering elk populations that migrate down from the ponderosa forests. These areas experience over use from the elk, which limits browse for other wildlife.

Exceptional Riparian Habitat Along Oak Creek:

Perhaps the most lush and dynamic plant community in the planning area exists in the riparian area associated with Oak Creek. Alder, maple, ash, aspen, and sycamore combine with elements of the pine/fir forest along the upper reaches of the West Fork and in Secret Canyon and Oak Creek. Twelve species of moss and 32 species of lichens are known to exist in the West Fork area. Because of its exceptional status and qualities, Oak Creek has been designated a "unique water" by the State of Arizona.

A short list of the many sensitive species found along Oak Creek includes:

Narrow-headed garter snakes

Narrow-headed garter snakes live in Oak Creek, preferring quiet waters with rocky pools. These snakes don't leave water except when pregnant females bask in sun to aid in embryonic development. They feed on fish, frogs, tadpoles and salamanders. When hunted, they escape capture by diving to the bottom and hiding under rocks.

Mexican garter snakes

Mexican garter snakes also live in the Oak Creek riparian zone, but unlike the narrow-headed garter snake, they prefer shallow, slow-moving waters where abundant aquatic vegetation provides good hiding places. Oak Creek provides good forage because insects are abundant in the vegetation; it provides thermal cover to help them regulate their body temperature, and it provides a place to attach eggs.

Heavy recreational use of Oak Creek reduces the amount of vegetation available for habitat by these and other species, which rely on riparian vegetation to play a critical role in their life cycles. For instance, although garter snakes and leopard frogs will lay eggs on twigs and other debris in water if vegetation is not present, they rarely lay eggs on the ground.

Native fishes

Historically the reaches of Oak Creek within the planning area provided habitat for five native fish species: the desert sucker, Sonora sucker, speckled dace, roundtail chub and Gila trout. Today, the suckers and dace can still be found in good numbers, but Gila trout are gone and the numbers of roundtail chub are reduced. The decline of these species throughout the Southwest has resulted in the federal listing of the Gila trout as an endangered species. The other four native fish are candidates for listing. Oak Creek can play an important role in the protection and recovery of these native fishes, but this role depends upon how we manage the aquatic habitat and non-native fish. The presence of non-native fish such as rainbow trout, brown trout, catfish, and bass, has likely contributed to the decline of roundtail chub and the disappearance of Gila trout.

Arizona bugbane

In addition to the animal life, this environment also provides habitat for one of four known populations of Arizona bugbane, a sensitive species of plant that lives within moist, forested area near perennial or intermittent streams. The moist habitat ranges from forest cover, riparian habitat (including springs), and the splash zones of water falls. Surrounding vegetation is generally mixed conifer with an understory of deciduous shrubs and trees that is often dense and shady. Arizona bugbane is found in the West Fork of Oak Creek, where heavy foot traffic is reducing the number of individual plants.

Water quality provides a foundation for the chain of life within the riparian system. High water quality in Oak Creek supports a thriving native insect population. Species that depend on insects for food, such as fish, frogs, insectivorous birds, and bats benefit from this abundant food source. Higher up the food chain, predators such as kingfishers and peregrine falcons feed on the fish and mammals that eat the insects. Any decrease in water quality threatens to disturb these relationships.

When looking at the water quality of streams in the planning area—especially Oak Creek—key factors include turbidity, temperature and bacteria levels. The natural range in the turbidity of Oak Creek allows for wide variability during the course of a year. Similarly, the temperature fluctuations that occur naturally provide a wide range. The upper portion of Oak Creek receives cool, spring fed waters. Farther downstream, below Sedona, the water warms. For the most part, current conditions in Oak Creek fall well within those natural sideboards for both turbidity and temperature.

Nevertheless, in such a system, timing of turbidity fluctuations becomes critical, because native aquatic species have adapted to the muddy-clear cycle. Any unseasonable turbidity, during a time when the water should normally run clear, can severely affect native animals.

In contrast to the wide natural range in turbidity and temperature, bacterial levels have increased beyond the natural amount. They often exceed State standards, leading to swimming closures at popular recreation spots. Many potential sources of bacteria have been identified, including effluent from the housing subdivisions between Sedona and Flagstaff; septic systems within the Oak Creek

Canyon; and recreational users of the Canyon. A correlation exists between periods of high runoff and high-bacteria levels, but no specific reason for this relationship has been found.

Fire:

Plant communities that had adapted to periodic fire occurrences have been replaced by less fire resistant (and now, more flammable) vegetation.

Ponderosa Pine

Ponderosa pine forests dominate higher elevations in the north part of the planning area, where abundant rain and snow pack provide more moisture during a longer duration of the year. In their natural condition, the pine forests maintain an open, park-like appearance allowing for vigorous herbaceous vegetation (grasses, fords and shrubs) below the canopy.

The plants and animals of this forest adapted to conditions where fire occurred regularly. Surface burning occurred at intervals ranging from two to 10 years. Many pre-settlement fires burned for months and covered thousands of acres.

Fire suppression has altered this regime. Without the frequent, low-intensity fires, open, park-like forests of ponderosa pine has given way to denser forests of Douglas fir, white fir, spruce or a combination of these species.

Fires that run through stands in this condition cause more damage because of the heavy buildup of woody debris, which burns more intensly. Fires also reach higher into the overstory trees by climbing up the multiple layers. Pre-Euroamerican settlement fires killed very few large, old trees. Major wildfires today can be intense enough to potentially kill nearly all trees spread over a large area, leaving little seed source for regeneration.

Pinyon-juniper

Pinyon pine and juniper cover a large portion of the planning area at lower elevations. Fire suppression has extended the area covered by this vegetation.

Once, fire, drought and natural competition played important roles in pinyon-juniper ecosystems. While drought and competition slowed the invasion and growth of junipers in adjacent grasslands, fire occurred about every 10 to 30 years, restricting the junipers to shallow, rocky soils and rough topography. On deeper soils, pinyon-juniper was a natural component of a Savannah-like pattern, where widely scattered trees dotted an otherwise open grassland. The condition was maintained through periodic low intensity fires which would kill the small trees and add nutrients to the soil to perpetuate the grasses.

The lack of fire has resulted in more than simply allowing the expansion of pinyon-juniper communities. Without fire, the grass and forb component of this vegetation community has declined, while the density of pinyon and juniper has increased. Long-standing grass savannahs have grown into heavy forests of pinyon-juniper with sparse grass underneath. This change began when grazing reduced the vigor of grasses. With the reduction in grasses, the primary source of continuous fuels was lost, leading to the reduction of fire in these stands. The fire exclusion has also affected the productivity of these sites. The diversity of plants and animals may also be declining with the change of the vegetative mosaic. Soil erosion is also

increasing in some areas due to fewer grasses and forbs to provide ground cover and reduce runoff.

Chaparral

As with the pinyon-juniper, chaparral in the study area is mostly even-aged and mature, resulting in little diversity of flora and fauna. Historically, these areas burned on a periodic basis, every 30 to 50 years. The component of grasses, forbs, and shrubs in these stands has declined and will continue to do so until fire is reintroduced.

In the absence of fire the chaparral plants become large and dense, with dead material accumulating beneath. This material, mostly branches, along with the greater biomass of the mature plants increases the available fuels. The volatility of this additional fuel leaves fewer stems from the burned plants after a fire and slows the recovery of the burned area.

Savannah-grasslands

In the Savannah-like transition zone between the forest and the grasslands, fires occurred periodically, at from one to 10 year intervals, which kept the trees out and allowed the grasses to flourish. Fire suppression has protected the pinyon-juniper while grazing has reduced the vigor of the grasses, resulting in the reduction of grasslands as the juniper extended its range. Grazing also spread seeds from hardy competitors such as mesquite, which develops an extensive root system to gather moisture. Mesquite now occupies territory once covered by open grasslands, making re-establishment of grasses difficult.

The grasslands within the planning area generally grow on relatively deep, limestone-based soils that support dozens of species of grass. Although these areas probably underwent a fire occurrence similar to the pinyon-juniper vegetation to the east, the growing conditions have not provided a favorable environment for establishment of pinyon-juniper, even after fire has been excluded. Therefore, up until recently these areas have remained dominated by grasses. As a result of recent heavy grazing pressure from cattle, and growth of shrub species such as creosote bush, crucifixion thorn and rabbit brush have increased as grasses have decreased.

...and Flood:

Streamside plant communities have also adapted to regular flooding, relying on the soil deposited and the clearing that occurs.

Human activities have not significantly influenced flooding patterns in Oak Creek. Flowing clear from spring-fed tributaries much of the year, Oak Creek follows the same pattern as other streams in the planning area, running muddy during the peak periods of runoff. This pattern might set off alarms in other regions of the United States, yet in the Sedona area, such high-energy water movement occurs often enough so that plants and animals within the system have adapted to the fluctuations between drought and flood. In fact, tree species such as cottonwood rely on periodic floods to clear out openings so that they can reproduce—much the same way ponderosa pine relies on fire. Other plant species, such as the Arizona bugbane, also benefit from this natural process.

Similarly, native fish benefit from reduced competition from non-native species because their life cycles align with the natural cycles of flood.

Little data exists to demonstrate a change in this flood regime in response to upstream changes to the watershed, such as road building, logging, or construction of housing subdivisions. Any activities that change the runoff pattern have the potential to increase the amount of water entering a stream, and so increase the level of peak flows. However, because of the natural variability of flows in the ecosystem, this factor does not play as significant a role as would be expected in a system adapted to steadier flows.

The ecology of Oak Creek depends on a flood regime. Any alteration of the periodic flood disturbance patterns in Oak Creek would profoundly change its character. Facilities in the flood plain that require flood control as part of their maintenance would alter this natural pattern.

Archeological And Historic Sites

World-Class, Little-Studied Archeology:

Rock art in the Sedona area is considered by many experts to be among the least understood and potentially one of the most significant rock art locations in the Southwest, comparable in terms of both scientific and aesthetic value to sites in South Africa and Australia.

Some of the prehistoric sites in the Sedona area represent a cultural group called the Southern Sinagua, unique to the Verde Valley. These people lived here from 1100 to 1300, during a major episode of prehistoric activity in the Southwest. In addition to the Sinagua presence found here, roasting pits and rock art display the most obvious and best evidence of Yavapai archaeology in the Verde Valley.

The prehistoric site densities in the Sedona area exceed 30 sites per square mile in some locations, which is exceptionally high by Southwestern standards. For the past decade, intensive efforts have been placed on recording six sites. This work has shown that these sites contain pictographs and petroglyphs that span the entire range of human occupation of the Verde Valley, stretching back 8000 years.

Only about 20 percent of the sites have been scientifically recorded. No sites in the planning area have been completely researched. These sites hold valuable information from which to piece together the story of ancient peoples. Visits to these sights offer Americans and people from around the world an opportunity to learn about this shared heritage. Yet once these sites have been altered, much of their research value is lost.

High Visitor Use:

Although this exceptional attraction brings thousands of tourists each year, almost none of the most popular sites have been developed to accommodate current or expected visitation levels. Consequently, heritage resources are being continually and rapidly destroyed. Although deterioration occurs from natural weathering, this normally slow process is accelerated with increased visits.

Regrettably, damage occurs primarily as a result of vandalism or because little interpretive or directional information exists at these sites. For example, informal pathways develop because trails are poorly marked; people remove artifacts for souvenirs usually because no information explains how this behavior can affect the research value of the site; or people "fix" a ruin or "freshen up" rock art because they are unaware of etiquette and law. Regardless of the reason, irreparable harm is done.

Education and interpretation are needed to get the message to the tourist about the significance and non-renewable nature of these sites. Visitors must understand and abide by the proper site behavior if these sites are to be protected and preserved.

Significant Cultural Heritage for American Indians:

This area is spiritually and intellectually important to several current-day American Indian Tribes. These include the Prescott Yavapai, the Yavapai-Tonto Apache, the Hopi and the Navahos. They value archeological sites for their cultural record and as the work of their ancestors. This significance can not be overstated. They also value the land, and come here for traditional collection and use of natural materials such as medicinal plants.

Because of the Federal legal protection and special significance of traditional cultural properties important to contemporary American Indian groups, planning must be particularly careful and sensitive regarding recreation and other activities in the planning area.

Recreation

High Visitor Use:

In 1995, more than 1.3 million people visited developed Forest sites on the Sedona District, a 48 percent increase since 1974. Of all the activities available, swimming, picnicking and scenic viewing account for 86 percent of the developed site use. Only 14 percent of visitors of developed sites use campgrounds with most use occuring at picnic, vista, and swimming sites. Most visitors stay less than a day and visit vistas or other day use sites. For instance, Oak Creek Vista on Highway 89A received more than 600,000 visitors in 1995. About 1000 roadside parking spots can be found in Oak Creek Canyon. Built during highway construction and maintainence operations, little attention has been given to designing road-side parking in Oak Creek Canyon so that parking can accomodate recreationists needs. Most facilities—which includes campgrounds—were constructed more than 25 years ago and no longer match the high demand for day-use activities. Access and facilities developed for day-use activities such as fishing, swimming and picnicking are limited.

Diverse Visitors, Diverse Reasons to Visit:

People come to Sedona District to visit scenic areas, historic places, and archaeological sites. They come to picnic, hike and walk for pleasure. Surveys show a demand for viewing historic and prehistoric sites; for bicycle lanes on Highway 89A; and for more and improved facilities where people can find directions and other visitor information. Also, demand has been expressed for an Oak Creek Trail to provide alternate transportation into the Oak Creek Canyon, as well as more picnic areas, flush toilets and showers, and walking trails.

At day use areas, half of the visitors are from out of state. In the campgrounds, nearly 60 percent of the visitors are Arizona residents, with another 20 percent calling California home. Campground users tend to come more often on repeat visits and stay longer, on average two to four days. People who come as day-use patrons tend to be first time visitors, and have brief stays, usually two to five hours.

Fishing makes up less than one percent of visitor use. In the upper reaches of Oak Creek above Sedona, the fishery consists primarily of planted rainbow trout and a small, self-sustaining population

of non-native brown trout. In Oak Creek downstream from Sedona, the water warms up and fishing is primarily for warmwater species such as the native roundtail chub, and non-natives, such as catfish and bass.

Hispanics account for over 32 percent of the use in some campgrounds, which has resulted in changing needs. Research has shown that Hispanic users tend to recreate in larger extended family groups, preferring larger camping and picnicking sites. However, developed sites in Oak Creek Canyon were built for small family groups. As a consequence, single-occupancy sites become joined together with informal trails, reducing the vegetation cover. This situation inconveniences the families that want to camp close together, as well as other campers, who may feel crowded out by the larger groups.

Believers of new age philosophies are another distinct group of people who come to the Sedona area. Activities associated with these visits focus on individuals searching for opportunities to reflect and contemplate, which are similar to the activities of others who come seeking quiet and solitude. The main difference is the interest in specific areas—Vortexes—which tend to draw the most attention: Airport Saddle, Bell Rock, Boynton Spires, Cathedral Rock and Cow Pies. Surveys conducted in 1995 show that more than 50 percent of visitors to Bell Rock and Airport Saddle come to experience a Vortex.

Recreation Concentrated in Sensitive Areas:

One of the most prominent dispersed use areas lies along Highway 89A, within Oak Creek Canyon, which receives more than 6 million travelers each year. Traffic often moves at a crawl, with numerous vehicles pulled off the road. Questions arise regarding the impact of this much traffic and auto exhaust to the water quality of Oak Creek.

This concentrated recreation use of Oak Creek Canyon has the greatest potential to impact the riparian ecosystem. Although adapted to wide ranges of temperature and turbidity, species are sensitive to unseasonable changes in sedimentation, water chemistry, and temperatures, specifically during the time of the year when Oak Creek normally runs clear. Swimming and wading in the Creek reduce the amount of aquatic vegetation, which reduces important habitat for species such as the threatened northern leopard frog and the Mexican garter snake. High visitor use contributes to declining water quality through increased sediment disturbance, automobile discharges, destruction of plant material, fecal contamination, paper and plastic litter, and other material left behind. Other recreational impacts include the competition of the rainbow trout fishery with native, threatened species.

On shore, a decline in the health of streamside plants raises concerns for the health of habitat for insects, which leads up the food chain to mammals, and to birds, such as the threatened peregrine falcon.

At several locations within the planning area—in particular Schnebly Hill and Dry Creek Road—dispersed uses such as camping and off-road driving have had severe impacts, especially to cryptiobiotic soils. This crust protects soils from erosion, helps retain moisture and nutrients and forms conditions for new plant life. Heavy foot and vehicle traffic in many areas around Sedona has removed this surface crust and exposed the underlying soil to erosion. Studies show that cryptobiotic soils take more than a decade to reestablish.

Forty-four sites have been identified where these types of soil and plant alterations are extreme. Inventories of 22 of these sites indicate that a quarter of these soils (600 of the 2,400 acres) has been laid bare by heavy use, with an equal acreage of trees and brush removed from these areas by human activities.

Places with the greatest damage include Schnebly Hill Road, Vultee Arch Road, Upper Red Rock Loop Road, Lower Red Rock Loop Road, Airport Saddle, Stage Stop, Sycamore Pass, Honanki, Long Canyon, South Fay Canyon and Dry Creek.

Similar concerns have been raised regarding disturbance to soils and vegetation at archeological sites that attract large numbers of visitors, and at sites that have also been identified as Vortex sites. For example, Bell Rock, in the Munds Mountain Wilderness, is a popular Vortex site. Dozens of medicine wheels are constructed there each year, causing disturbance to soil and vegetation. Smudging is another activity associated with new age visitors and involves building fires that threaten the integrity of rock art, as well as running the risk of causing wildfires.

Wilderness

High Visitor Use, Short-Term Use:

More than 224,000 persons each year visit Sedona's three Wilderness areas, more than visit the Superstition Wilderness near Phoenix, the Kachina Peaks Wilderness near Flagstaff, and comparable with the highly visited Wemenuche Wilderness in the San Juan Mountains of Colorado.

In places such as Bell Rock and West Fork of Oak Creek up to 12,000 vehicles per day travel within a few hundred feet of the Wilderness boundary. In 1995 more than 54,000 people visited West Fork of Oak Creek in the Red Rock-Secret Mt. Wilderness. More than 47,000 people accessed the same Wilderness area through Boynton Canyon in 1995. Large numbers of visitors are unaware that they are in a designated Wilderness area.

Ninety-eight percent of Wilderness use is day use and more than half of this use occurs at only three areas: West Fork of Oak Creek, Boynton Canyon and Bell Rock. Most of this visitation is from outside of Arizona, with very short length of stay the general rule. Surveys show that most of these visitors are hiking and siteseeing and seeking "restorative" benefits from these activities. Restorative benefits include "getting away from the usual demands of life, experiencing natural quiet, solitude, and resting mentally".

Changes to Wilderness Character:

Although there is "crowding" at some more accessible sites, people express a high level of satisfaction with their hiking experiences. On the other hand, aircraft flights over more remote areas raise concerns about noise detracting from the experience of natural quiet and solitude.

Wilderness sites most damaged by recreationists include Bell Rock, Boynton Canyon, West Fork of Oak Creek, and Forest lands immediately adjacent to the City of Sedona. Because of the lack of support facilities, such as parking, and signs and interpretation, damage occurs to soils and vegetation as people create their own parking places, stray off poorly marked trails, and otherwise damage the sensitive environment. Also, many visitors do not appreciate how vulnerable the soils and plants are to disturbance.

The increase in aircraft overflights—both private and commercial—has diminished the experience of natural quiet in the more remote portions of these Wilderness areas. In addition to unknown number of private flights, six commercial air tour companies fly over the Sedona area, using the Sedona

Airport as their base of operations. Several other companies tour the Sedona area but fly out of Phoenix, Flagstaff and the Grand Canyon.

A century of fire suppression has caused dramatic changes in plant and wildlife communities. Re-introduction of fire into the Wilderness ecosystem was identified as the number one priority in the 1995 Coconino National Forest Wilderness Review.

Falling Short of Wilderness Goals:

The exceptional natural qualities of these rugged Wilderness areas are well suited to provide primitive recreation, quiet and solitude. However, the location of these Wilderness areas and the current patterns of recreational use present significant challenges to carrying out the intent of the Wilderness Act.

Commercial Use

Increasing Demand for Commercial Guided Ecotourism:

Sedona attracts ecotourism, where currently more than 20 outfitter guides under Forest Service permit provide services, primarily to fill the demand of visitors to see and learn about the natural history and ecosystems of the area. This includes one helicopter company, six Jeep tour companies, two horse trail-riding companies, two hot-air balloon companies, and seven hiking tour companies.

Whether by 4x4, helicopter, balloon, horse or foot, these tours meet a growing demand to see the red rock country up close and to learn about its history, geology, plants and wildlife. The most popular means of touring seems to be traveling low maintenance roads by Jeep.

Because of Sedona's natural beauty and urban conveniences, the demand for permits for additional outfitter/guide operations continues to grow. Over 30 new applications were recieved in 1995 alone. Many of these were applications for mountain bike tour services. While outfitters and guides provide an important service, there is also potential for these activities to affect residential settings where National Forest access is located, and to affect other recreational activities and natural and cultural resources in the forest.

Strong Demand for Commercial Filming Use:

In the Sedona/Oak creek planning area, the stunning visual contrasts and diversity make this one of the most photogenic–and photographed–areas of the region. Tourists, professional photographers and commercial and movie film crews use the red rocks for a backdrop, and have done so for decades. Filming is an important economic factor in Sedona as well as Arizona and the area continues to be promoted by the Arizona Film Commission and local Chamber of Commerce. More than 80 filming permits were issued on the district in 1995 to advertise products such as Jeep, Nissan, Cadillac, Chrysler, Taco Bell, Yamaha and for many fashion magazines and catalogs and feature films.

New Approaches Needed to Meet Demand and Prevent Impacts:

To a great extent, permit administration controls the amount of environmental impact caused by these services, yet potential exists for damage to soils, vegetation, and cultural resources; for disruption of wildlife; and for increased conflicts with other users.

For instance, concern is growing over effects to the solitude and natural quiet of back country areas as a result of frequency and elevation of aircraft overflights. The Forest Service continues to receive complaints from back country hikers about the impacts of aircraft overflights that intrude on the solitude of back country visitors. Six airtour companies currently overfly the Sedona area, many of whom are sensitive to the FAA altitude advisory to remain 2,000 feet above ground level. However, many private aircraft also fly over the area and may not be aware of the advisory or of the sensitive nature of the wildlife, archeological and human conditions below them. Although the Forest Service has discussed these concerns with the Federal Aviation Administration, the FAA has sole jurisdiction to manage aircraft overflights.

Other sources of local income include commercial services that rent four wheel drive vehicles, and mountain bikes. Although these activities often take place on National Forest lands, the Forest Service has no authority over this type of commercial activity. Renters are often unaware of restrictions in Wilderness areas and other sensitive places. They may be unaware of the fragile character of the soil and plant life and consequently cause impacts to the environment. These impacts may be mitigated through education. For instance, recent surveys of four-wheel-drive rental outfitters indicate that companies are making sincere efforts to properly orient their clients.

Meanwhile, although filming causes few direct effects, areas most frequently in demand for filming—such as Slide Rock, Schnebly Hill, Red Rock Crossing, and Broken Arrow—are also those that are in demand by hikers, photographers, and other recreationists. Filming activities add to traffic and parking congestion, as well as causing conflicts between users during these activities, diminishing the quality of the recreation experience.

Community Relationships

High Value of the National Forest to Locals:

Comments from residents and recent local surveys indicate that National Forest lands provide significant benefits to residents in the form of open space, recreation opportunities and scenery. A large portion of residents are fairly new to the Sedona and unfamiliar with the unique and sensitive environment. Nevertheless, people want to live in Sedona and they are concerned about protection of their environment. Also, as more visitors find their way to the trailheads located in subdivisions, residents are more likely to feel crowded out. At the same time, residents make their way into the Forest along a web of unmaintained "social trails" that allow access from their back yards. These trails can cause impacts to soils and plants.

Many residents are concerned about the growth in the Sedona area. The community is divided into those who want development and those who want to limit development. Many land exchanges have occurred in the Sedona area, mostly between 1970 and 1980, which provided private land for existing residential and commercial developments. Land exchanges have also provided National Forest lands for public purposes such as the Sedona Red Rock High School and the Sedona Cultural Park. There is a continued concern about where and how future land adjustments and exchanges should occur in this area. Many residents would like to retain National Forest lands for their open space and recreational values and limit any additional community growth to the existing private lands.

Increasing Risk of Fire as Development Moves to Outlying Areas:

In the wildland-urban interface, the threat of fire and damage to structures and/or loss of human life has increased as more developments move close to National Forest lands. This risk has been enlarged by historic fire suppression efforts, which have led to changes in vegetation composition and structure. These changes place people and structures at risk when coupled with residential development in the urban/forest interface in the Sedona area.

Although prescribed burning has the potential to lessen this risk, implementing prescribed fire has become more expensive and complex due to heavy buildup of woody debris and the dense stands of small trees. In addition, State air quality and visibility standards are becoming more restrictive regarding prescribed fire emissions.

Across all of these vegetation types, firefighting has become more difficult as the accumulation of fuels has grown heavier and as the distribution of the fuels has become more uniform across the landscape. This means that as more development occurs away from the main population centers of the planning area, property becomes more difficult to protect.

Increasing Demand for Infrastructure on National Forest land:

Information in the Sedona Community Plan reveals that by the year 2010 the population of Sedona could increase 75 percent over what it is today. A growing population within Sedona will increase demands on roads, electricity, natural gas and services such as water, garbage and sewage. As the existing private land base is developed, utility companies are finding it very difficult to obtain private lands to meet growth demands, and therefore they turn to National Forest System lands.

Ecological Impact Correlates with Rapid Development:

There are several outlying isolated private land parcels within the planning area. These parcels have been zoned by the county as either low density residential or for resort use. As the Verde Valley and Sedona continue to grow, these parcels will be subdivided to their approved zoning, for over 700 individual parcels or home sites surrounded by otherwise undeveloped National Forest land. With this development comes infrastructure needs as well as upgraded transportation corridors to support the increased use.

Resort development of isolated parcels, as seen at Enchantment Resort, creates pressures on surrounding National Forest lands besides infrastructure. Resorts promote their ability to provide many activities both on-site and nearby, resulting in requests for use of the National Forest for guiding and special events as well as hiking, biking, and horse uses.

On adjacent National Forest land as well as along access corridors, the way these outlying parcels develop can profoundly influence the quality of the environment. For example, one of the greatest threats to the District's herd of pronghorn antelope comes from habitat fragmentation. Antelope movement is greatly restricted by roads especially when fenced. Antelope are reluctant to cross under fences (even with smooth bottom wires) and are even more reluctant to jump fences. Habitat fragmentation in antelope habitat occurs anywhere fences are constructed. This includes areas where any roads, pasture fences, private land, or non-National Forest land ownership exists. Habitat fragmentation is and will continue to reduce the size of antelope range in the Verde Valley. If fragmentation begins to impede the Verde Valley herd's attempts to breed with the adjacent Northern and Cement herds, the population could decline.

Another potential impact results from soil disturbance associated with development along roadways and utility corridors, which allows exotic plant species to invade the area to the detriment of native plant and wildlife.