# Centennial Forest Plan
***September 2002***

## Introduction

***Charge to the Technical Committee*:** The Centennial Forest Technical Committee will consist of experts in the fields of silviculture, forest management, forest health, wildlife, archeology, geology, and other fields of interest. The committee will meet periodically with the Centennial Forest Management Team to discuss feasibility and technical aspects of research, education and management activities. The Technical Committee will meet monthly during the NAU academic year first to develop the Forest Plan and later to monitor it's implementation via Annual Operating Plans. The committee is to represent the broad interests of the Arizona university community with regards to research, education, demonstration and sustainable management of Centennial Forest lands.

***Purpose of this Forest Plan:*** The purpose of the Forest Plan is to direct decisions regarding long-term sustainability of forest health, ecological restoration goals, and ecosystem-based management. The Forest Plan is the long-range planning document for the Centennial Forest land base – the Annual Operating Plan guides the near-term specifics, which over the years will largely precipitate from the Forest Plan **vision** coupled with various funding opportunities for research, education and demonstration. At a minimum, the Forest Plan address the extent of our understanding of the resource relative to strategies for restoration and ecosystem management, fire-risk reduction, recreation, natural resources utilization, research, grazing, grant development, and archaeological opportunities (in the arbitrary order established by the Intergovernmental Agreement). In reality, the Forest Plan needs to address much more.

***Management Vision:*** The Centennial Forest Advisory Board has established four vision statements to guide the Plan:

> 1) Ecologically- and economically-sustainable managed forest that demonstrates and maintains a diversity of forest conditions and management options.
>
> 2) Research/teaching focus for all environmental programs at NAU and proving ground of a world-class Forestry School/Environmental University.
>
> 3) Field campus: Environmental Camp, Research Laboratory, overnight cabins, Forest Resources Enterprise Center, Retreat Center.
>
> 4) Forest that is linked to the greater community and contributes positively to open space, fire prevention and the overall quality of life and economic health of Flagstaff.

In addition, the Intergovernmental Agreement establishing the Centennial Forest states that our mission is: "*to further the Parties' mutual interest in: 1) forest ecosystem health; 2) maintenance of the natural assets and values of the state-held educational trust lands; 3) reduction of the risk of wildfire; and 4) long-term ecological research*" Combining these guidelines produces a vision that spans four fundamental but overlapping areas:

Teaching: Both undergraduate and graduate teaching opportunities will be available for the entire NAU community, well beyond strict “Forestry” and “Parks and Recreation Management” classes. Example courses could come from the College of Ecosystem Science and Management’s "Applied Indigenous Studies" or "Geography and Public Planning" departments, and across campus from Environmental Sciences, Political and Social sciences, Archeology, Anthropology, Engineering, and Business Administration.

Research**:** Both undergraduate and graduate research opportunities will be available in the forests, woodlands and grasslands (and their associated natural and cultural resources) and at Field Campus facilities (with potential NEON or other program collaboration).

Demonstration**:** Demonstrations of various habitat conditions (single replicates outside of any research framework), materials engineering strategies, new technologies, and/or business opportunities will be available.

Revenue Production: Most teaching, research and demonstration activities should have the potential to generate income from resource extraction, user fees, site fees, and overhead.

***Relations to Arizona State Land Department:*** The vision contained in this Forest Plan is consistent with management policy and objectives established in the “Forest and Woodland Management Policy” adopted by the Land Department in 1992 and described in their Timber Management Plan for timbered State Trust Lands in northern Arizona. Much of the material in this Forest Plan quotes or paraphrases language in that Plan. Generally, it gives direction for the consideration and enhancement of numerous aspects of these forest ecosystems while managing the forest for potential revenue production. These include:

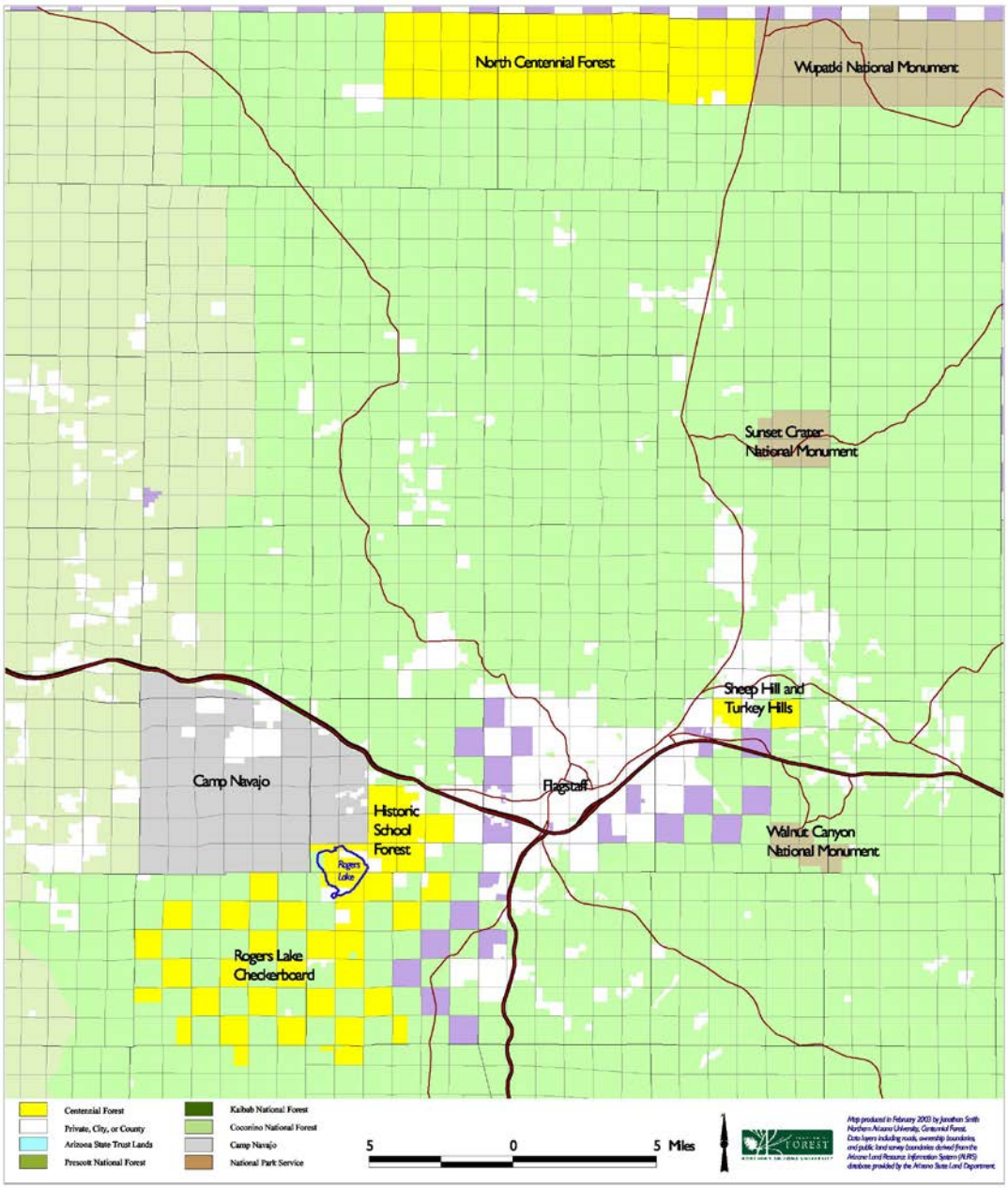
1. Biodiversity
2. Forest Health
3. Fire protection
4. Local forest-dependent businesses
5. Soil and water quality
6. Riparian and wetland values
7. Watershed and water quality
8. Threatened and endangered species
9. Air quality
10. Real estate values on urban Trust land parcels, or parcels that may be within areas of future development potential.

This Centennial Forest Plan establishes an **ecosystem-based management** emphasis for **long-term research, education and demonstration** for these same broad ecosystem considerations, which are similarly consistent with the above-stated revenue production potential. In reality, timber production is not currently a revenue generating option for these lands and the likelihood of conflict between emphases is minimal; that potential for conflict can be easily managed should a market for timber products return to the region. However, there is major potential for conflict centered on the disposal of State Lands for development (#10) that cannot be accommodated in a forest management plan such as this.

# Overview

The Northern Arizona University Centennial Forest covers more the 47,000 acres (19,000 hectares) of forests and grasslands in the vicinity of the San Francisco Peaks and Flagstaff. The Forest is a mix of contiguous ownership and interspersed sections with the Coconino National Forest and, to a very limited extent, private lands.

These ecosystems contain a wealth of biological and cultural resources across a wide gradient of environmental conditions, detailed in this Forest Plan. Given these differences, the Forest will be managed as four units based on contiguity of the land, vegetation type, and socioeconomic relevance.



***Centennial Forest management unit size and dominant vegetation***

| Management Unit Name | Area (acres) | Dominant Vegetation Type |
|---|---|---|
| Historic School Forest | 3,998 | Ponderosa pine forest type |
| Rogers Lake Checkerboard | 17,759 | Ponderosa pine forest type |
| Turkey Hills - Sheep Hill | 1,210 | Ponderosa pine forest type |
| North Centennial Forest | 24,506 | Savannah/Grassland type |

***Historic School Forest:*** The Historic School Forest (HSF) management unit is the largest contiguous block of forest vegetation on the Centennial Forest, and it represents our best opportunity for large-scale demonstration of restoration and sustainable management of southwestern ponderosa pine. It is comprised mostly of a closed ponderosa pine forest type with scattered meadows and canyon fringe ecosystems. Much of the area is impacted by roads and associated human activities given its close proximity to Flagstaff's suburban growth boundary. For these reasons, this unit is the logical choice for locating the core of our Field Campus with its educational, recreational, experimental and entrepreneurial facilities.

***Rogers Lake Checkerboard***: This "checkerboard" management unit is a large block of ponderosa pine forests intermixed with (primarily) Forest Service ownership. Road densities and human impacts are slightly lower than the HSF throughout most of the checkerboard. The eastern and western edges are framed by Woody Ridge and Sycamore Canyon, respectively, while the northern edge borders Rogers Lake. Management in this area will focus on research and demonstration of various sustainable management strategies.

***The Turkey Hills - Sheep Hill Management Unit:*** This management unit is comprised of only two land sections on the northeastern edge of Flagstaff's urban boundary. The density of grassy meadows is higher in these sections, though the unit is still considered a ponderosa pine forest type, and it holds abundant cultural resources. Perennial water is also available in the Sheep Hill section given waste-water discharge from the city of Flagstaff. Management of this area will necessarily focus on recreational and cultural resources with the potential for "created" wetland and riparian systems.

***North Centennial Forest:*** The North Centennial Forest management unit includes grasslands with extensive pockets of juniper savannah/woodland type. It is another large contiguous ownership but dominated by non-forest type vegetation and located significantly distant from Flagstaff. Management will focus on grassland and savannah research and demonstration, including grazing and juniper encroachment issues.

# PART I: The Resource

The resource section of the Centennial Forest Plan summarizes available data, information and/or our broader understandings of the biological and cultural resources present on the Forest and surrounding landscape. This 'picture' is as complete as possible at this time, but should evolve rapidly over the coming decade given a strong vision for improved understanding of the resource via inventories and surveys.

## 1.1 Geology, Watershed and Soils Resources

### 1.1.1 Historic School Forest and Rogers Lake Checkerboard

This part of Mogollon Rim in northern Arizona is comprised predominately of elevated plains dissected by ridges and escarpments with scattered valley plains and basins. Highly eroded lava flows, cinder cones, and calderas are the most prominent topographic features of the region.

Soils are derived primarily from basalt parent material with variable concentrations of cinders, forming clay loams and rocky clay loams that are moderately productive (Table 1.1). Such soils, however, are easily compacted when wet but only slightly erodeable under appropriate management. Full Terrestrial Ecosystem Survey (TES) descriptions are available for this area.

***Table 1.1*** *Soil parent material and management implications in the HSF and RLC*

| TES category | % of area | Acres | Texture | Compaction Risk | Erosion risk |
|---|---|---|---|---|---|
| Basalt/cinders | 88 | 18,985 | Clay loam | Moderate - High | Low |
| Benmorite | 7 | 1,490 | Clay loam | Moderate - High | Low |
| Limestone/sandstone | 4 | 951 | Loam | Moderate - High | Moderate |
| Cinders dominated | 1 | 279 | Coarse | Low | Moderate |
| Andesite | 0.1 | 12 | Loam | Low | Moderate |

Steep slopes, ridges and escarpments are most prominent in the southwestern portion of the Rogers Lake Checkerboard where drainages approach the highly dissected canyon country of Volunteer and Sycamore Canyons. Steep slopes also occur along the north-south line of Woody Ridge and associated landforms along the eastern portion of the HSF. The prominent basin of Rogers Lake and prairie of Fry Park cover approximately 2,000 acres, with additional flat alluvial features scattered throughout the HSF and RLCB.

### 1.1.2 Turkey Hills - Sheep Hill

Geology and landform in these two sections are similarly comprised of elevated plains and ridges/scarps, but is dominated by its namesake cinder cone formations - Sheep Hill in section 4 and the Turkey Hills in section 2. Soils are basalt derived with heavy influence from cinders, and consist primarily of spatially mixed fine texture clay loams and coarse cinder soils. These sections drain into the Doney Park area and ultimately into the Little Colorado River to the northeast.

***Table 1.2*** *Soil parent material and management implications in the TH-SH*

| TES category | % of area | Acres | Texture | Compaction Risk | Erosion risk |
|---|---|---|---|---|---|
| Basalt/cinders | 55 | 663 | Clay loam | Moderate - High | Low |
| Cinders dominated | 43 | 520 | Coarse | Low | Moderate |
| Mixed igneous | 2 | 27 | Loam with surface rock | Low | Low |

### 1.1.3 North Centennial Forest

This area sits on the edge of the San Francisco Volcanic field, with its most northern parts showing underlying sedimentary formations. Soils are dominated by a history of grassland conditions with heavy influence of cinders in many areas. Detailed soils inventories via the US Forest Service Terrestrial Ecosystem Survey (or any other system) are not available and, therefore, a priority need for this unit. The area drains into the Little Colorado River basin generally to the northeast.

## 1.2 Land Cover and Vegetation Resources

### 1.2.1 Historic School Forest and Rogers Lake Checkerboard

Vegetation in these two zones southwest of Flagstaff is dominated by ponderosa pine overstory with scattered meadows; a detailed look at the Terrestrial Ecosystem Survey classification and how it fits into the surrounding landscape is available for this area (Figure 1.1). Pine canopies have variable overstory cover and many associated species in the mid- and understory (Table 1.2).

***Table 1.3*** *Vegetation composition in the HSF and RLCB*

| Community | % of area | Tree (%) | Shrub (%) | Forb (%) | Graminoid (%) |
|---|---|---|---|---|---|
| **Pipo/Quga** | 78 | 60-90 | 0-10 | 5-15 | 10-20 |
| **Meadow grasses** | 14 | 0 | 0-10 | 10-40 | 50-90 |
| **Pipo/Fear** | 4 | 50-95 | 0-5 | 5-10 | 10-40 |
| **Pipo/Jude/Quga** | 4 | 66 | 5 | 6 | 12 |
| **Pipo/Jude/Qutu** | 0.3 | 56 | 11 | 6 | 7 |
| **Potr/Psme** | 0.1 | 80 | 2 | 16 | 2 |

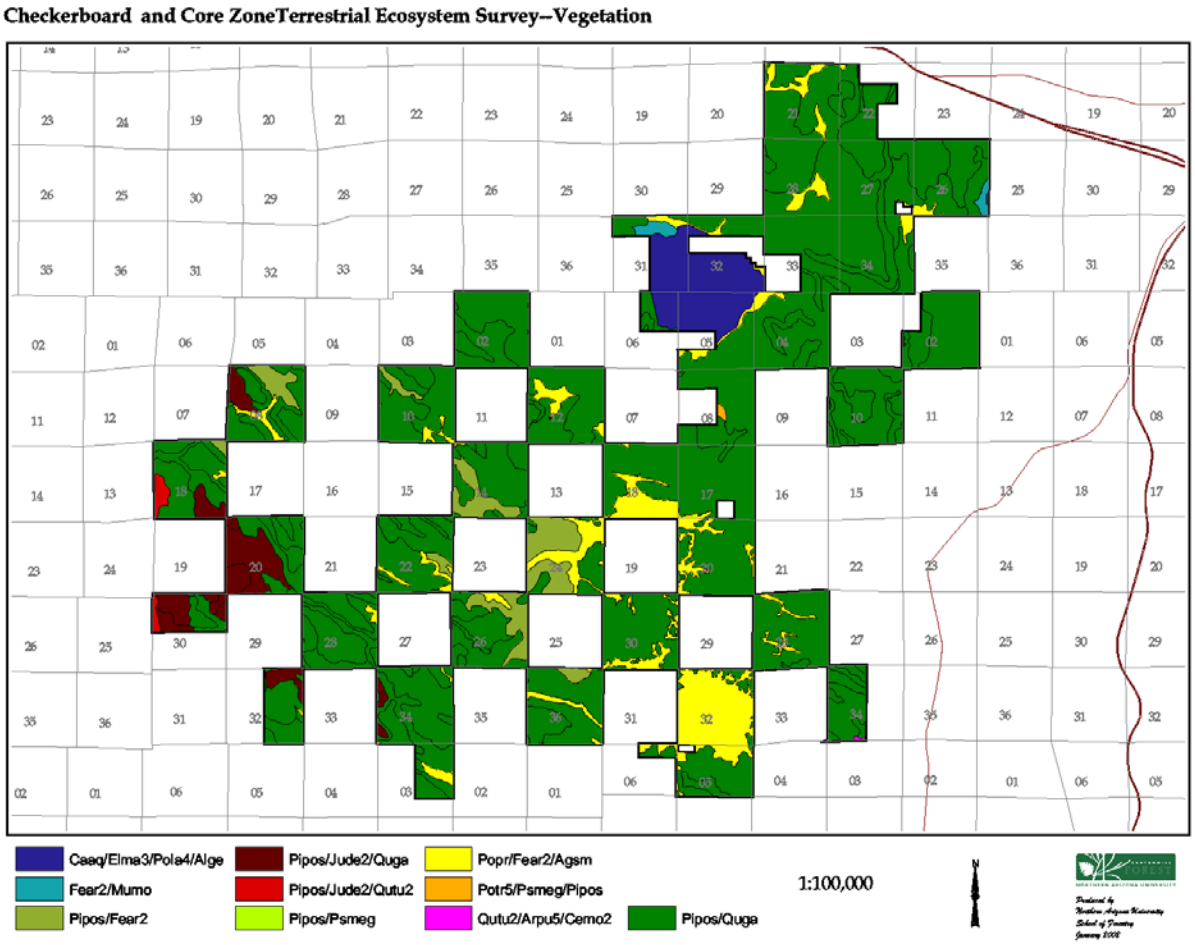



***Figure 1.1*** *Terrestrial Ecosystem Survey vegetation patterns of the Checkerboard and Historic School Forest Management Units.*

Tree densities are typically high relative to presettlement conditions and sustainable ecosystem management, dominated by Vegetation Structural Stage (VSS) class 3 and 4 stands, comprised primarily of 5-18" diameter trees. Vegetation Structural Stage class 5 and 6 "old-growth" stands are rare in this landscape despite the fact that the parts of the Historic School Forest have some of the highest concentrations of yellow pine in the Flagstaff area. The predominance, approximately 90% of the stands, of overstocked small-to-mid diameter trees at historically high densities, and arrayed in continuous ($\geq$45%) canopies has resulted in severely reduced understory production and increased fire risk, among other ecosystem problems (e.g., the risk of significant bark beetle outbreaks).

Meadows are found interspersed among the ponderosa pine overstory and near small streambeds. These semi-arid grasslands are dominated by non-woody plants, especially graminoids, with a relatively diverse forb community showing pronounced seasonality. Stands of Gambel oak (*Quercus gambelii*) occur infrequently in grasslands along with other deep-rooted shrubs. The dominant grasses in this area are *Festuca arizonica*, *Muhlenbergia spp*., *Blepharoneuron tricholepis*, *Bouteloua gracilis*, and *Elymus elymoides*. Similar to other areas throughout the arid West, grasslands are thought to have declined in extent and species diversity over the past century, as the suppression of fire, the introduction of domestic

livestock, and changing climatic patters have allowed for the encroachment of woody vegetation. Most meadows on the Centennial Forest have at least a few small trees in them.

Canyon and escarpment vegetation, particularly to the west, contains some small tree and shrub-size oaks with junipers and scattered overstory ponderosa pine. To the east, such escarpment vegetation includes the small riparian/wetland fringe areas. Aspen is relatively rare in this landscape.

### 1.2.2 Turkey Hills - Sheep Hill

Vegetation in these two sections is similarly dominated by several ponderosa pine communities, with abundant pinyon pine in the mid- and understory on the cinder cones themselves. Meadows are scattered, where coarse cinder soils are unfavorable to the establishment of dense grassland; however, robust stands dominated by *Bouteloua gracilis*, and *Elymus elymoides* are present in some areas.

### 1.2.3 North Centennial Forest

Extensive grasslands cover approximately 50-60% of this unit. Encroachment by juniper woodland vegetation is evident, and some researchers hypothesize that the grassland/woodland boundary is shifting at an increasing rate, due to land use practices and climatic change. Dominant grasses in this area include *Bouteloua eriopoda*, *Sporobolus airiodes*, and *Pleuraphis jamesii*. Detailed mapping of vegetation in the NCF is not yet available.

## 1.3 Fuels accumulation and fire ecology

Fire is an important disturbance process influencing forest composition and structure, stand dynamics, and fuel accumulation. Surface fires regulated tree regeneration throughout the Southwest prior to 1870, favoring open stands of large trees with a productive herbaceous understory. Nutrients in forest litter were released through combustion. As a consequence of the fire-maintained forest structure, plant diversity and soil moisture were high, providing diverse resources for microorganisms, arthropods, and other wildlife. In the absence of fire, dense stands of young trees have developed and understory plants have diminished. Heavy forest floor and canopy fuels now facilitate large-scale intense burning, causing mortality, soil erosion, and altering successional trajectories toward exotic and weedy species.

### 1.3.1 Historic School Forest and Rogers Lake Checkerboard

Ponderosa pine - Gambel oak forests **had** frequent surface fires covering up to thousands of acres and burning for as long as months at a time prior to European settlement (circa 1870). Average mean fire intervals across the Southwest ranged from 4-6 years, but fire recurrence varied from fires in subsequent years to as long as 15-20+ years between fires. Within the perimeter of any given fire, burning intensity varied from unburned areas to mortality of individual trees or groups. Lightning density in the Southwest was/is high, but human-caused fires also occurred. Forest resources such as wildlife were highly valued by Native Americans, whose use of fire has been widely documented. Such frequent surface fires regulated pine and oak regeneration, favoring open stands of large trees with a productive herbaceous understory.

The predominant fire regime since 1870 has been **complete exclusion of fire**, punctuated by infrequent, stand-replacing fires. Euro-American settlement was accompanied by scattered harvesting of desirable trees and heavy livestock grazing, eliminating fire spread. Active fire suppression was the general policy throughout most of the twentieth century. In the absence of fire, dense stands of young trees have

developed and understory plants have diminished. Heavy forest floor and canopy fuels now facilitate large-scale intense burning, causing mortality, soil erosion, and altering successional trajectories toward exotic and weedy species.

***Surface Fuels:*** surface fuels in pine-oak forests consist of litter, woody debris, and herbaceous plants. Fire behavior fuel models include model 2 (mixed grass and timber) and 9 (long-needled conifer). Corresponding fire danger fuel models are C (open pine with grass) and U (western long-needled pine). Surface fuels are increased by tree mortality and activities such as thinning. Where activity fuel (slash) is present, the potential fire behavior is more intense. Slash fire behavior fuel models include models 11 and 12, fire danger fuel models K and J. Surface fuels are reduced by decay, fire, and treatments such as chipping. Surface fuel accumulation data for the Historic School Forest shows an average of 10-15 tons/acre.

***Crown fuels:*** crown fuels include foliage and fine twigs of living trees. Important attributes of crown fuels are the crown bulk density (related to the hazard of active crown fire) and the crown base height (the "fuel ladder" than can support passive crown fire). Crown fuels are affected by natural stand dynamics, such as regeneration, tree growth, and mortality, and by silvicultural treatments.

Beginning in the 1960's and increasing to the present, a variety of policies have supported some degree of fire in the landscape through prescribed burning, prescribed natural fire, and wildland fire use for resource benefits. Although the benefits of periodic surface in ponderosa pine forests are now widely accepted, the challenges of heavy fuel accumulations, smoke, risk of fire escape, and limited funds have kept fire use to minimal levels.

### 1.3.2 Turkey Hill - Sheep Hill

The pine-oak ecosystem in these two sections was similarly maintained by **frequent, low-intensity fire** and, consequently, has been similarly altered through fire exclusion in the last Century.

### 1.3.3 North Centennial Forest

1.3.3.1 Pinyon pine - juniper woodlands

Although fire is thought to have been the most important disturbance process in pinyon-juniper ecosystems prior to Euro-American settlement of the western US, presettlement fire regimes in these woodlands are **poorly understood**. Fire evidence is often limited to interpretations of written accounts and tree age structure in stands since the dominant woody species seldom form fire scars. From the research that has been done, it is apparent that fire regimes were highly variable and a function of site characteristics such as soil texture and topography as well as geographic location. Fire return intervals in pinyon-juniper have been reported to be as short as 20 years to as long as 90 years. On some sites, intense fires may have burned every few hundred years.

As in other forest types, fire in pinyon-juniper systems had many ecological functions. Where frequent fires burned, stands were likely kept open with productive understories of grasses, forbs, and shrubs. Low-intensity fires constrained establishment of trees and stimulated production of vigorous new growth on re-sprouting woody species, important to browse, that are often common in these ecosystems. In more intense burns, communities were likely returned to an earlier seral stage dominated by re-sprouting species and those that established from soil seed banks. Return to a pinyon-juniper type under these conditions is thought to have been a relatively slow process.

Presently, woody fuel buildups in many pinyon-juniper systems are high are propagule pools are depleted due to intensive grazing, soil loss, and fire exclusion. Under these conditions, severe fires and further degradation in the form of increased soil erosion and invasion of exotic plant species are real threats.

***Surface Fuels:*** surface fuels in pinyon-juniper forests consist of litter, woody debris, and herbaceous plants. Fuel loadings are generally lower than for pine-oak forests. The primary fire behavior fuel model is 6 (dormant brush). The corresponding fire danger fuel model is F (intermediate brush). Surface fuels are increased by tree mortality and activities such as thinning. Surface fuels are reduced by decay, fire, and treatments such as chipping.

***Crown fuels:*** important features of pinyon-juniper crown fuels are the same as those described for pine-oak, above.

Pinyon-juniper woodlands provide many valuable resources and amenities and have been important to humans for millennia. Over the last 120 years or so, these ecosystems have been managed to varying degrees for fuel wood, livestock forage, wildlife habitat, cover for watershed protection, and special products such as pinyon nuts and fence posts. Cattle-grazing has been a common use of these lands and chaining or cabling to remove pinyon and juniper trees has occurred over large areas where increases in forage for animals was desired. As in other forest types, fires have been actively suppressed throughout the range of pinyon-juniper woodlands.

1.3.3.2 Grasslands

Fire regimes of grasslands are poorly understood in the Southwest. The absence (or low number) of trees in grasslands has limited the use of fire scar analysis to reconstruct past fire. Descriptions from early European settlers in Arizona suggest that range fires on productive grassland sites may have been intense and large in area. In grassland ecosystems around the role, fire plays important ecological roles by removing dead plant material, recycling and volatilizing nutrients, and killing young trees that otherwise would encroach on the grassland.

Heavy livestock grazing in the late $19^{th}$ and early $20^{th}$ centuries, combined with drought and fire exclusion, are believed to have led to an extended period of fire exclusion in grasslands as well as invasion by woody species such as pinyon, juniper, or sagebrush. Grassland fires were widely suppressed by resource management agencies through the twentieth century. However, active management to control woody species invasion by cutting or chaining trees such as pinyon pine and juniper trees was widely practiced.

***Grassland fuels****:* consist of living and dead herbaceous plants, predominantly graminoids. The primary fire behavior fuel model is 1 (short grass). The corresponding fire danger fuel model is L (western perennials). Grassland fuels are increased by herbaceous growth, especially in years with favorable moisture. Fuels are decreased by herbivory from wild and domestic animals.

## 1.4 Wildlife Resources

### 1.4.1 Historic School Forest and Rogers Lake Checkerboard

Animal biodiversity of these areas is typical of ponderosa pine forests, containing some species of regional concern due to their rarity, importance as game species, or popularity. In addition, some key habitat elements, such as snags, logs, and yellow pines, may be limited in abundance.

***Vertebrate species of concern****:* The **Mexican spotted owl** is listed as "threatened" under the federal Endangered Species Act (ESA) and is the only listed vertebrate species known to breed on the Centennial Forest . There are 2 known Protected Activity Centers (PACs) on the Centennial Forest:

- Dry Lake PAC - 589 acres; and
- La Barron PAC - 598 acres.

The ASLD and USFS have surveyed for Mexican spotted owls on most of the suitable habitat in the Centennial Forest several times since 1993. However, some areas were only surveyed once (1993-1994), and other areas have never been surveyed. Because owls could occur on unsurveyed sites, and could move into previously-surveyed sites, the Centennial Forest must survey for owls (in appropriate habitat) within 1 year of any activity that may affect owls.

Management activities must consider impacts on Mexican spotted owl for activities within a PAC, within 1 mile of a PAC, or within **restricted habitat**. Our two PACs occupy 1187 acres or 5**.**3% of these pine forests. About 9631 acres (43%) lie within one mile of these or within a mile of six PACs on adjacent USFS land (Figure 1.2). Probably less than 20% of the Centennial Forest meets the criteria for restricted habitat, and much of this probably falls within PACs or the 1-mile buffers around PACs. Thus, the impacts on Mexican spotted owl must be considered when planning activities on about half of this Management Area.

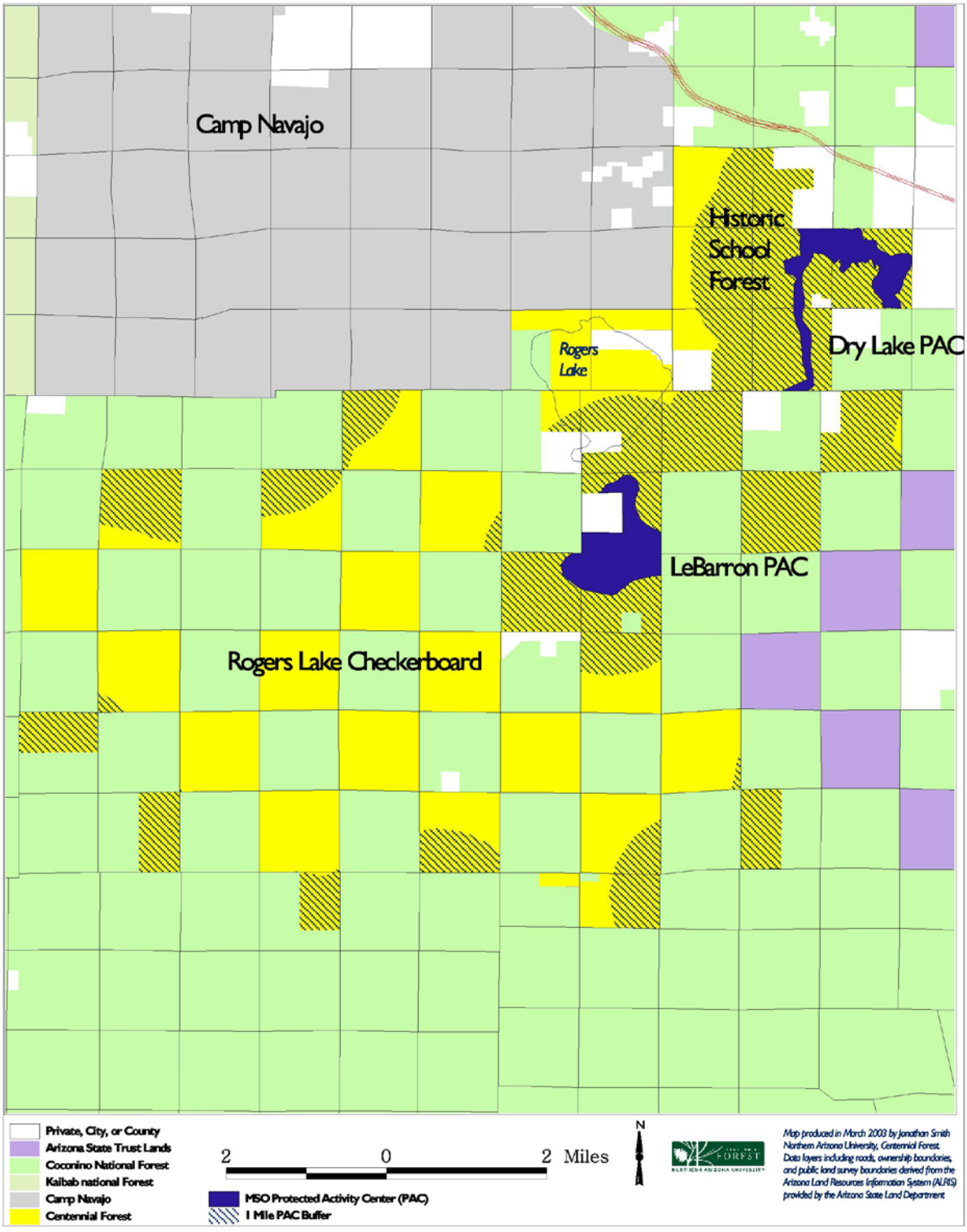



**Figure *1.2*** *Mexican Spotted Owl Protected Activity Centers on the Centennial Forest*

The **northern goshawk** is listed by the Forest Service as a "sensitive species" in Region 3. A 1996 Record of Decision amended forest plans in Region 3 to require that all ponderosa pine habitat on National Forest land be managed according to certain prescriptions designed to enhance habitat for goshawks. The ASLD and Centennial Forest are under no obligation to follow these guidelines; the US Fish and Wildlife Service (FWS) has twice rejected petitions to have the goshawk listed under ESA. There are no known goshawk nests on the Centennial Forest, but this is almost certainly due to lack of inventory effort. A rigorous survey would probably reveal a few goshawk territories on the Centennial Forest.

The Coconino National Forest has mapped one goshawk management territory in one section surrounded by Centennial Forest sections. However, this territory was designated solely on the basis of what appeared to be a large stick nest in a ponderosa pine first noted in about 1995. In visits to the site in 4 subsequent breeding seasons, there has been no sign of goshawks at or near the nest tree.

Two other federally listed species – **peregrine falcons** and wintering **bald eagles** – have been occasionally seen on or near the Centennial Forest. A summer roost of bald eagles was observed in Dry Lake (within what is now the Dry Lake PAC) in about 1993 (K. Pajkos, ASLD, personal communication, January 2002). Aside from this observation, there is no reason to suspect that either species breeds in this Management Area or that this Management Area provides critical habitat for these species.

***Game species**:* The Centennial Forest contains excellent **turkey** habitat in some areas. The Arizona Game and Fish Department (AGFD) is interested in maintaining both summer habitats and connective habitats (as yet unidentified) by which turkeys migrate to and from wintering habitat to the south. Sizeable populations of **Abert squirrels, mule deer, and elk** occur on the Centennial Forest; AGFD is concerned about declining mule deer numbers throughout the state. **Pronghorn** are not abundant in these pine forests, but may find important habitat in the northwest, near Rogers Lake and Garland Prairie. Little is known about this pronghorn population. However, most pronghorn populations in Arizona are declining, including nearby populations on Anderson Mesa and Chino Valley. Thus, we must seriously consider how activities might enhance or impact pronghorn habitat in the Rogers Lake area.

Rogers Lake is by far the largest ephemeral wetland in this Management Area, and provides unique habitat values. It contains very little year-long open water, but can grow to several hundred acres during spring snowmelt. No surveys have been conducted to indicate the extent to which **waterfowl** may use the lake for breeding or during spring or fall migrations. Similarly, there may be a few bird species characteristic of more mesic conditions in the Centennial Forest's few deep canyons (mostly on the margins of the Centennial Forest ) or steep north-facing slopes. These species may include red-face warblers, summer tanagers, and painted redstarts.

*Wildlife of Special Concern in Arizona* (draft AGFD document 1996) is a list of 113 "species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines." Several of these species (excluding species also listed under federal ESA) may occur in this Management Area, including: osprey, ferruginous hawk, American redstart, pine grosbeak, and leopard frogs. In 2001, *Arizona Partners in Flight* (APIF) listed 41 bird species as conservation priorities in Arizona. Six of these species are known to occur in the Management Area, namely band-tailed pigeon, black-throated gray warbler, gray flycatcher, Mexican spotted owl, olive-sided flycatcher, and pinyon jay. In addition, 12 other APIF priority species probably occur here (burrowing owl, cordilleran flycatcher, golden-crowned kinglet, northern goshawk, purple martin, red-faced warbler, red-naped sapsucker) or may occur here (ferruginous hawk, MacGillivray's warbler, pine grosbeak, Swainson's thrush, three-toed woodpecker).

***Special habitat elements:*** In many areas of these ponderosa pine forests, the scarcity of large snags, logs, yellow pines, and Gambel oak trees may potentially limit some wildlife populations. The distribution and abundance of these special habitat elements are not known, but the low occurrence of old-growth conditions (see Land Cover and Vegetation Map) is indicative of the low occurrence of these elements. In summer 2001, we conducted line transects (270 m apart) for goshawks, and noted occurrences of large snags (≥12 inches dbh ), logs (≥15"4 ft long), large oaks (≥10" drc), and yellow pines (≥16" dbh, yellow bark, and open crown) within 16 m of the transect line. The areas surveyed in 2001 include the entire Core Area (Historic School Forest), plus sections 20, 26, 30, and 32 in T20NR6E, Sections 5 and 6 (about 300 acres) in T19NR6E, and sections 24, 26, and 36 in T20NR5E. Maps depicting the density of these habitat elements, and summary tables, should be available soon.

### 1.4.2 Turkey Hills - Sheep Hill

These two sections contain no known Mexican spotted owl habitat. Surveys for goshawks should be conducted prior to any management activities (e.g., tree-cutting or prescribed fire) in these sections. The Rio de Flag has perennial flow in this area (due to discharge from the City of Flagstaff water treatment plant), and may attract a few passerine bird species not otherwise common in this area. The perennial flow also may make this a stopover point for migrating birds. The possible APIF bird species and Arizona Wildlife of Special Concern are probably the same as for the Historic School Forest and Rogers Lake Checkerboard Management Areas.

### 1.4.3 Northern Grasslands Management Area

***Vertebrate species of concern:*** No threatened or endangered species are known to occur in this zone, but it may contain potential habitat for the black-footed ferret (*Mustela nigripes*) that is listed as endangered under ESA. Prairie dogs (*Cynomys gunnisoni*) are the principal (perhaps only) food for the ferret, which also uses prairie dog burrows for shelter and travel. Thus, the existence of prairie dog colonies is a necessary condition for ferrets to occur on a site. The Centennial Forest is within the historic range of the ferret (Hoffmeister 1986), and prairie dogs do occur on the site. Ferrets probably have not occurred in the vicinity for several decades, but captive-bred ferrets are being reintroduced in Arizona and elsewhere. Thus, ferrets could re-colonize the Centennial Forest in the foreseeable future, or could be reintroduced there.

All species of prairie dogs are of conservation concern, in part because the recent spread of plague (*Yersina pestis*) from Eurasia has exacerbated the previous effects of persecution and habitat loss. The Gunnison prairie dog occurs in the Management Area.

Arizona Wildlife of Special Concern ... The 2001 Arizona Partners in Flight list of priority bird species includes 7 species that probably occur in this Management Area (black-throated gray warbler, burrowing owl, ferruginous hawk, gray flycatcher, gray vireo, juniper titmouse, pinyon jay), and one species that may occur here (Baird's sparrow).

## 1.5 Cultural Resources

The Centennial Forest encompasses three distinct environmental zones that present very different challenges and opportunities for prehistoric and historic human populations. The diversity of environments provides an excellent natural laboratory for pursuing comparative studies of human adaptation to a variety of natural and cultural landscapes. Unfortunately, **there is no comprehensive**

**inventory of cultural resources in the Centennial Forest**, and information on the location, distribution, contents, significance, and integrity of individual sites is incomplete or, for some areas, nonexistent.

The most thoroughly surveyed area thus far is the Historic School Forest and Rogers Lake Checkerboard, which has the lowest potential for cultural resources. The area with the highest potential is the Turkey Hills – Sheep Hill management unit, which has been subjected to a systematic survey only in the Sheep Hill section. Virtually no information of any sort exists for cultural resources in the North Centennial Foest, and its potential can be judged only by comparison with adjacent areas (such as Wupatki National Monument and the Upper Basin of the Grand Canyon) that have had systematic cultural resource inventories. Obviously, more inventory data are needed from all areas; however, a preliminary sketch of the resource base can be offered based on environmental characteristics and existing survey area.

### 1.5.1 Historic School Forest and Rogers Lake Checkerboard

The Historic School Forest and Rogers Lake Checkerboard lie in a high-elevation ponderosa pine forest that would have provided some opportunities for **hunting and gathering** of wild resources, but would have had very little potential for farming. A short growing season and soils with a high clay content would have limited the amount of food that could have been grown, and hence the level of prehistoric human population that could have been sustained. In historic times, the area has been intermittently used for a variety of purposes, principally logging and herding.

Numerically, most of the cultural resources known or anticipated for this area are likely to be **historic-age (post 1880) sites** such as railroad beds, camps and other sites associated with logging, and a few scattered herding camps. Prehistoric sites are small and widely dispersed, probably associated with hunting and gathering activities pursued episodically by multiple cultural groups at a low level of intensity over several thousand years. In some areas, visibility is hampered by a thick cover of pine duff that obscures surface artifacts, so the true density of sites is difficult to evaluate. However, even in areas where visibility is adequate, prehistoric site densities are not high, and remains are not substantial. Habitation sites and architectural remains are not known nor anticipated to be a major component of the cultural resource base, due to the lack of agricultural potential.

Part of the area has been surveyed by personnel from the Arizona State Land Department, and adjacent parcels of the Coconino National Forest have been inventoried by Forest Service archaeologists. As expected for this environment, these surveys have revealed artifact scatters left by prehistoric populations engaged in seasonal hunting and gathering activities, historic-age railroad beds and other logging-related remains, and a few historic camps or trash areas. Overall, given the results of these surveys and what is known from similar environments in the surrounding area, the sensitivity, research potential, and interpretive potential of cultural resources is thought to be relatively low.

### 1.5.2 Turkey Hills - Sheep Hill

In contrast to the HSF/RLC unit, the Turkey Hills - Sheep Hill management unit would have offered good opportunities for **prehistoric farmers**. This is due to a lower elevation setting, allowing for a longer growing season, and the presence of good soils for farming. Erosion of volcanic products from the San Francisco Peaks and Mount Elden and the intermittent deposition of volcanic ash from cinder cone volcanoes have promoted the development of light, arable soils suitable for prehistoric cultivation techniques and crops. In addition, this area is cut by the Rio de Flag, a major drainage of the southeastern side of the San Francisco Peaks. In prehistoric times the Rio de Flag would have provided a reliable source of drinking water, and seasonal flooding of its channel would allowed for irrigation or floodwater

farming. The Rio de Flag also would have been a logical route of travel from the San Francisco Peaks to the Little Colorado River, providing an additional stimulus for settlement along its course.

No systematic cultural resource inventories have been conducted on the Turkey Hills; Sheep Hill has been 100% surveyed. As early as 1916, reconnaissance surveys were conducted by Harold Colton and his staff from the Museum of Northern Arizona along the Rio de Flag, and systematic surveys have been conducted by the ASLD and the CNF in adjacent areas of State Land and the Coconino National Forest. These efforts have documented that the Turkey Hills – Sheep Hill unit has a very high potential for cultural resources, and that these resources are sensitive and highly significant. Most of the sites in this area are prehistoric in age, affiliated with the Sinagua culture, ca. AD 700 to 1300. Two of the largest prehistoric pueblos in the Flagstaff area, Elden Pueblo and Turkey Hill Pueblo, lie within a few kilometers of the Turkey Hills – Sheep Hill parcels. These large pueblos were built as the culmination of widespread prehistoric settlement in the area. During their peak (ca. AD 1150 to 1300), Elden and Turkey Hills pueblos were the centers of occupation for a community of smaller pueblos and pithouse sites that, in the aggregate, housed several hundred people. It is likely that most of the cultural resources within the Turkey Hills – Sheep Hill were part of the greater communities that were focused around Elden and Turkey Hills pueblos.

Previous inventories have documented the presence of a wide variety of sites in the Turkey Hills – Sheep Hill parcels. These include petroglyph sites; habitation sites with small pueblos, burial sites, kivas, pithouses, trash mounds, and other features; scatters of surface artifacts; and small masonry structures that were probably used as “field houses” during the cultivation of nearby crops. These remains are highly sensitive to disturbance, have a high research and interpretive potential, and are undoubtedly significant to regional Native American populations, particularly the Hopi.

### 1.5.3 North Centennial Forest

The cultural resources of the North Centennial Forest management unit are difficult to assess because there has been virtually no inventory. A low-elevation setting provides for a long growing season, but soil fertility and dry climatic conditions may have inhibited farming potential. The grassland would have supported populations of antelope and other game animals, and in some areas there is potential for wild food resources such as grasses and cacti, but these resources are not abundant and they could have been obtained only on a seasonal basis. On the other hand, previous surveys of adjacent areas such as Wupatki National Monument and the Upper Basin of the Grand Canyon have shown a considerable density and diversity of cultural resources, including small pueblos and 'pithouse' settlements dating to the pueblo period of occupation, ca. AD 500 to 1300. Hence, lacking inventory data, it is difficult to assess the potential number and quality of cultural resources for the Wupatki Grasslands. The best guess at present is that there will be a moderate density of sites in this zone, including some habitation sites, and that most will date to the prehistoric pueblo period. Given the geographical location of this unit, most sites will likely be affiliated with the prehistoric Cohonina or Kayenta Anasazi cultures.

## 1.6 Recreation Resources

The Centennial Forest provides outstanding opportunities for dispersed recreation in northern Arizona as complement to surrounding federal lands (see Access and Community Influences section). The forest cover, road system and proximity to Flagstaff are all conducive to a range of recreational opportunities. However, much of the current use is undocumented, unmonitored and largely illegal trespass on State Trust Lands.

**Recreation use permits** have been required since the early 1980's to use State Trust lands, but a continued lack of resources has made enforcing this requirement difficult. These permits were designed to allow the public access to State Trust lands for "nonconsumptive and environmentally compatible recreation activities" (*AZ State Land Department Recreation Permits Brochure, 2000*). Permitted recreational activities include: hiking, horseback riding, picnicking, family reunions, bicycling, photography, sightseeing, bird-watching, off-highway vehicle use on established roads and trails, and organized club events. Camping is restricted to no more than seven days. In addition to having a recreation use permit, access to State Trust lands is also permitted to hunters and anglers with valid hunting or fishing licenses who are **actively pursuing their sport**.

As Flagstaff has grown as a community, the number of people wanting access to the forested areas surrounding Flagstaff has increased, and will likely continue so. This is putting increased recreation use pressure on US Forest Service and Centennial Forest lands for dispersed recreation opportunities. The three management units of the Forest are attracting somewhat different types and amounts of recreation use.

### 1.6.1 Historic School Forest

The Historic School Forest unit is lightly- to moderately-used for recreation. The area is primarily accessed by County and Forest Service **primitive and better than primitive** roads, inventoried and GPS-mapped by School of Forestry students in 2001. Recreation activities include hunting, driving for pleasure, partying, hiking, wildlife viewing, horseback riding, and target shooting.

A **Recreation Opportunity Spectrum** (ROS) map was created for the Historic School Forest management unit in 2001 by School of Forestry Semester C students. This analysis identified the dispersed recreation opportunities for the area based on the ROS system currently used by the U.S. Forest Service to map and manage recreation opportunities. The area is dominated by Semi-primitive Motorized and Natural Motorized recreation. No formal survey has been conducted on the amount of recreation use that occurs in the area.

There are no developed recreation facilities in the Historic School Forest management unit. There is, however, evidence of sustained recreation use of selected sites throughout the area such as hunting camps, general campsites, and day use sites. These areas tend to be located near water (e.g., tanks) or areas with high scenic beauty and are subject to sustained, sometimes seasonal, recreation use. These "special places" also have been inventoried and mapped by School of Forestry Semester C students.

### 1.6.2 Rogers Lake Checkerboard

Less is known about the recreation use of the Rogers Lake Checkerboard management unit since no formal inventories have been conducted on the amount and type of recreation use, roads, special places, or recreation opportunities available. Evidence suggests that this area receives **light to moderate recreation use** primarily by hunters, sightseers, campers, and folks driving for pleasure in conjunction with their experiences on US Forest Service lands. Access to the area is provided on primitive and better than primitive roads maintained by the County and/or US Forest Service.

### 1.6.3 Turkey Hills-Sheep Hill

The Turkey Hills-Sheep Hill management unit is the area of the Centennial Forest **most heavily** impacted by recreation use. This area is near a rapidly growing residential area and is easily accessed by developed

and better than primitive roads. No formal inventories have been conducted on the amount and types of recreation use, roads, special places, or recreation opportunities available. Evidence suggests that this area receives moderate recreation use, much of it by local residents using the area for hiking, walking their dogs, horseback riding, ATV-driving, and partying. There are significant archaeological resources in this area that need protection from recreation use and other illegal activities such as illegal trash dumping and littering.

### 1.6.4 North Centennial Forest

The North Centennial Forest management unit is the most remote in the Centennial Forest and appears to receive only light recreation use. Accessed primarily off Hwy 89N by better than primitive roads, the area offers outstanding opportunities for observing the r**emnants of volcanic activity**. SP Crater and SP Lava Flow attract hikers and OHV users. No formal inventory has been done on the amount and types of recreation use, roads, special places, or recreation opportunities available. Evidence suggests that the area is used by hunters, campers, sightseers, OHV users, and hikers.

## 1.7 Access and community influences

### 1.7.1. Adjacent Land Use and Zoning

1.7.1.1 Historic School Forest and Rogers Lake Checkerboard

The southern portion of this area is in a predominately checkerboard land pattern with Coconino National Forest lands. Much of this land base serves an **open space function** and is under the county designation "OS". Other adjacent governmental land use includes the Naval Observatory and Camp Navajo, where restrictive boundaries exist due to the nature of activities (e.g., storing and disposing of munitions). Small tracts of land are also owned by the City of Flagstaff; they maintain several city wells adjacent to the Historic School Forest. The quasi-public land uses include the adjacent non-profit Arboretum and 247 acres of the Dry Lake area. This Dry Lake acreage is currently overseen by the Grand Canyon Trust with the objective of turning the land over to the Coconino National Forest for permanent management.

These Centennial Forest lands are located near **growing residential areas**. While overall there is not a large quantity of surrounding private land, there are residential subdivisions that are adjacent (e.g., Westwood Estates) or nearby (e.g., Equestrian Estates), and a large acreage of residential lots is found adjacent to Rogers Lake. The Flagstaff Ranch and Golf Course subdivision near Dry Lake is zoned as a "planned residential development"; it does not have a determined lot size. Small agricultural (ranching) interests are also interspersed within the unit, including adjacent private-public lands.

In addition to residential and agriculture uses, some private commercial and industrial enterprises are adjacent to or near this management unit. Nearby private commercial businesses include the Woody Mountain Campground recreation facilities and store at the intersection of Woody Mountain Road and numerous business establishments along Route 66.

1.7.1.2 Turkey Hills - Sheep Hill

Most notable in these sections is the city's Wildcat Wastewater Treatment Plant adjacent to the Sheep Hill section. The Turkey Hills-Sheep Hill area is near the Doney Park Planning Area, also a rapidly growing residential space. Cinder mining and the El Paso gas pipeline easement affect the Sheep Hill section and industrial zoned land and uses are nearby. Both sections in this area have power transmission lines that

cross the parcels. These sections are also within close proximity of the Nestle Purina manufacturing plant and Flagstaff East Core redevelopment project currently in the planning phase.

1.7.1.2. North Centennial Forest

Adjacent land in the north section is mostly government owned and includes consolidated Forest Service property, the Wupatki National Monument, and state-private lands in a checkerboard pattern. Adjacent land uses include those allowed by the Forest Service, ranching, education and research (NAU fieldtrips to SP crater and the SP Lava Flow and subsequent research), the Hanks Trading Post as well as the nearby national monument. The southeast portion of this north unit is transected by two power transmission lines. Coconino County's designation for the area is general with a 10-acre minimum.

## 1.7.2. Circulation

Major motorized access to the Historic School Forest and Rogers Lake Checkerboard management units is provided by primary highway Route 66 and Woody Mountain Road, a partially paved local access roadway (see HSF Road Map). Route 66 is maintained by the Arizona Department of Transportation; Woody Mountain Road is maintained by Coconino County to the US Forest Service boundary. This road is currently unpaved into the Centennial Forest area but may be paved within the next 3-5 years. The sections adjacent to the south unit as well as internal to the area can be accessed by a prolific network of unimproved dirt roads including 75, 526, 527, 530, 231, 538, 536A, 68, 530 and 535 maintained by Forest Service, Coconino County and Arizona State Land Department.

The Turkey Hills-Sheep Hill sections are accessed indirectly from Route 66 and Camp Townsend Winona Road using unimproved roads 791 and 510B or private tracks.

Major access to the North Centennial Forest and the adjacent land is from Highway 89 although indirect access can be gained off Highway 180 as well. Adjacent unimproved dirt roads provide access into the consolidated state lands of the north unit. These include 417 and 416, as well as unimproved tracks that enter the area from the north and east.

A more comprehensive road condition and use survey and subsequent GIS overlay is needed in order to create an appropriate circulation plan. This should include the Centennial Forest lands as well as adjacent areas as routes will inevitably contact or use lands under different ownership such as those of the US Forest Service. The nature and location of road agreements between the US Forest Service and the Arizona State Land Department is an important factor in planning the uses within the Centennial Forest.

## 1.7.3. Viewsheds

Viewsheds are scenic landscapes visible from transportation corridors. The preservation of an aesthetic landscape is an important economic and socio-cultural objective in the Flagstaff region, therefore the conservation of viewsheds along transportation corridors is an important facet of land management. The northern extent of the forested Historic School Forest is visible from Interstate 40 just west of Flagstaff.

Numerous cinder hills, including the Turkey Hills section provide an important viewshed for the Flagstaff metropolitan area as the city is approached from the east along I-40. Changes in this landscape will be particularly visible along this major travel route. The North Centennial Forest provides a sweeping viewshed visible from both Highway 180 and Highway 89. The cinder cones have a significant visual impact in this region as does the open expanse. Combined, they create a unique sense of place.

### 1.7.4. Neighboring Recreation and Trails

1.7.4.1. Recreation

Surrounding US Forest Service lands offer serve a diverse recreating population with unimproved recreation opportunities: hiking, sightseeing, driving for pleasure, wildlife viewing and dispersed camping. Arizona Game and Fish sells hunting permits that include Centennial Forest lands with US Forest Service lands in Units 6a and 7. The Rogers Lake area and the portions of the Turkey Hills - Sheep Hill sections have been designated as "**neighborwoods**" areas in the Flagstaff Area Open Space and Greenways Plan. Neighborwoods are natural open space areas somewhat modified by man, that are located near urban areas. These provide areas for quickly leaving the urban environment, and can serve as a buffer between urban developments. Coconino County also provides organized and unorganized recreational uses such as horse racing, the county fair, special events and day use gathering places within Fort Tuthill, a regional park on nearby Arizona State Trust lands. As urbanization continues near the southern portions of the Centennial Forest, suburban interface areas are likely to be heavily impacted by increasing recreational use. Even in the remote North Centennial Forest management unit, some degradation has already occurred due to illegal four wheeling on SP crater.

1.7.4.2. Trails

As a part of regional circulation planning, adjacent trails (formal and informal) that access the Centennial Forest need to be mapped and classified in order to better understand the access patterns of users. As a GIS overlay, this would be informative when combined with overlays of roads and sensitive or research areas.

## 1.8 Leases, Permits and Utilization

Under the Intergovernmental Agreement Creating the Centennial Forest, on-going leasing activities are allowed to continue. Lease activities can include mining, right of ways, commercial activity, and grazing. Currently there are no mining or commercial leases on the Forest. Right-of-way agreements and leases occur throughout the Forest including electrical power line and roads rights-of-way.

With few exceptions, the entire Centennial Forest is leased for grazing purposes. The Forest is divided into four grazing allotments, three for cattle grazing, and one sheep allotment.

## 1.9 Dark Sky and Astronomical Resources

The suitability of the local topography, cloud conditions, and atmospheric clarity for casual skygazing and astronomical research has been recognized at least since the establishment of Lowell Observatory in the Flagstaff area in 1894.

The region now boasts an active astronomical research community of seven research facilities, including Lowell Observatory at Mars Hill and on Anderson Mesa, the U.S. Naval Observatory Flagstaff Station, the Navy Prototype Optical Interferometer (NPOI) at Anderson Mesa, the National Undergraduate Research Observatory on Anderson Mesa, Arizona State University's Braeside Observatory, and NAU's Atmospheric Research Observatory.

Local units of the National Park System likewise are recognizing the value of this dark sky resource to their parks and visitor experience. As urban areas of the state and country become increasingly light polluted, park visitors value the view of the starry sky still available at these local units. Sunset Crater National Monument offers camping facilities and regular evening programs, while Walnut Canyon and Wupatki National Monuments offer occasional night activities and plan to increase these activities in the future dependent on funding.

Only the U.S. Naval Observatory Flagstaff Station and Braeside Observatory are located directly adjacent to the CF, but all of the astronomical facilities are potentially affected by uses of the CF lands should they be developed in ways that use substantial amounts of light or affect atmospheric clarity through dust or air pollution. By their nature, air and light pollution affect areas far beyond the boundaries of the lands on which they are produced.

The worldwide inventory of premier astronomical regions is short, and getting shorter as development intrudes into formerly undeveloped areas. Some of the world's formerly best astronomical sites along the coastal ranges of Southern California have been severely degraded by the tremendous growth in the region, with attendant light and air pollution. As populations and development increase worldwide, impacts on formerly remote astronomical sites increase, making the preservation of every quality site increasingly important.

# PART II: The Vision

The **vision** part of the Centennial Forest Plan focuses on the desired future condition and resultant management needs within the next three to five years. The core of all vision statements is the conservation of biological and cultural resources across the Forest. We have tried to develop some specific ideas in each topic area to truly characterize the vision; however, the true specifics are most appropriately described in the **Annual Operating Plans**.

## 2.1 Land Management Vision: Geology, Watersheds and Soils

Land management activities will have **neutral or positive** long-term large-scale impacts on the physical and chemical characteristics of our geologic and soil resources across the Centennial Forest. We will:

- minimize the surface area permanently impacted by official roads, campsites, parking and structures. Many of these areas will be located in already degraded areas;
- actively restore all other degraded areas (e.g., unnecessary roads, unofficial tracks and inappropriate campsites) and monitor the recovery of such areas over the long-term;
- isolate to the extent possible and/or mediate the impacts of mining operations;
- conduct all land management (e.g., harvest operations, grazing, and recreation) and research/educational activities in such a way as to minimize near-term compaction, erosion and/or disruption of natural processes associated with decomposition and nutrient cycling;
- provide educational opportunities for NAU students to learn about northern Arizona geology and soils, and their appropriate management; and
- supply infrastructure and opportunities for applied and basic research related to geology and soils.

Near- and long-term research and demonstration projects will enhance our understanding of soil responses to various land management options **across all zones**. Adaptive land management will incorporate this increased understanding over time. Of initial interest are responses to:

- forest and savannah restoration treatments, with and without fire;
- grazing intensity and frequency;
- camping intensity;
- trail location and use intensity;
- exotic vegetation.

## 2.2 Land Management Vision: Land Cover and Vegetation

Land management activities on the Centennial Forest will sustain the physical and biological integrity of vegetation communities and populations across the landscape. We will:

- actively restore, enhance and/or sustain rare plant species and communities;
- actively restore, enhance and/or sustain reference sites;
- restore degraded communities and ecosystems and monitor their recovery over the long-term;
- isolate and mediate the negative impacts of degrading activities (e.g., road, facility, trail and campsite construction, and mining operations);
- conduct all land management activities (e.g., harvest operations, grazing, mining and recreation) and research/educational activities in such a way as to minimize near-term disruption of natural structure, composition or function;
- provide educational opportunities for NAU students to learn about native vegetation and its appropriate management; and
- supply infrastructure and opportunities for applied and basic research related to plant populations, communities and ecosystems.

Near- and long-term research and demonstration projects will enhance our understanding of vegetation responses to various land management options **across all zones**. Adaptive land management will incorporate this increased understanding over time. Of initial interest are responses to:

- forest and savannah restoration treatments, with and without fire;
- grazing intensity and frequency;
- camping intensity;
- trail location and use intensity;
- exotic vegetation.

## 2.3 Land Management Vision: Fuels and fire management

Fuel and fire management on the Centennial Forest will restore fire-adapted ecosystem characteristics in both forests and grasslands at a landscape level. Large areas of pine-oak forests will be in open forest conditions of large, mature trees with a productive herbaceous understory. Pinyon-juniper forests will occupy historic woodland sites, while grass will reclaim invaded areas. Surface fire will be appropriately frequent in all ecosystem types, through management policies of wildland fire use and prescribed burning.

Forest structures and fuels will thereby become resistant to stand-replacing fire, protecting forest resources and the wildland/urban interface. Smoke levels will be low and burning windows will be wide because fuel hazards will be minimal.

Specific goals **across all zones** include:

- maintain clear policies for wildland fire use and prescribed burning, supported by interagency agreements and utilizing existing Arizona State Land Department facilities and staff;
- restore fire-adapted forest structures through mechanical treatments and prescribed fire across the landscape;
- experiment with and monitor fire-adapted ecosystems to improve management techniques; and
- provide large-scale demonstrations for public education.

The Centennial Forest can be a leader in the West for developing innovative ecosystem management methods in fire-adapted forests. All fire management activities in Centennial Forest will be carried out under an approved plan administered by the Arizona State Lands Department. The plan will take into account overall forest management objectives, the natural role of fire disturbance, values at risk from wildfire—especially the wildland/urban interface—and ecological priorities such as rare species.

### 2.3.1 Fire Management Zones

The Centennial Forest will be divided into **zones** for appropriate fire management response. Zones with high fuel hazards or high values at risk—such as the wildland/urban interface—will be managed for rapid suppression response to wildland fires. Zones with low fuel hazards, few values at risk, and relatively minor smoke impacts, will be managed with a wildland fire use policy (see below). If necessary, additional zones will be delineated.

In all zones, active forest restoration treatments will utilize management-ignited fires where deemed appropriate for meeting management goals.

### 2.3.2 Wildland Fire Use Policy

Where feasible and appropriate, Centennial Forest will follow the Federal wildland fire use policy: "Based upon sound scientific information and land, resource, and fire management objectives, wildland fire is used to restore and maintain healthy ecosystems and to minimize undesirable fire effects. Fire management practices are consistent for areas with similar management objectives, regardless of jurisdiction" (http://www.fs.fed.us/land/wdfire.htm).

### 2.3.3 Fire Suppression

Fire suppression in Centennial Forest will be carried out by the Arizona State Land Department and neighboring agencies operating under existing cooperative agreements.

### 2.3.4 Prescribed Burning

Management-ignited fires will be used to meet objectives such as restoration of the ecological role of fire and fuel reduction. Burning prescriptions will be developed following specific guidelines in the fire management plan, incorporating the following elements:

- Description of goal and objectives.
- Description of site and fuels.
- Required conditions of weather, moisture, and fire management resources.
- Contingency plan.
- Fire personnel qualifications and safety plan.
- Go/No-Go checklist.

### 2.3.5 Air Quality

The air shed of Centennial Forest includes the City of Flagstaff and other communities, National Monuments and Wilderness Areas, the Navajo and Hopi Nations, and scenic areas such as Oak Creek Canyon and Grand Canyon. Fire management in Centennial Forest will be sensitive to air quality in the following ways:

- Smoke impacts of management-ignited fires will be assessed and permission to burn will be obtained from the Arizona Department of Environmental Quality.
- Management-ignited fires and other treatments will be used frequently to eliminate excessive forest floor and woody debris fuels and to encourage growth of herbaceous fuels, which produce less smoke under both controlled and uncontrolled burning conditions.

## 2.4 Land Management Vision: Wildlife Resources

The Centennial Forest will be an excellent steward of our animal resources. We will:

- maintain an inventory of rare species and special habitat elements;
- restore, enhance and/or protect habitat for threatened and endangered species;
- cooperate with AGFD in maintaining populations of game and non-game species;
- prevent or limit the invasion of exotic species;
- provide educational opportunities for NAU students to learn about the ecology and management of wildlife and wildlife habitat; and
- supply infrastructure and opportunities for applied and basic research related to wildlife.

The Centennial Forest is an ideal location for education in wildlife ecology and management for undergraduates in the Forestry professional program, Environmental Sciences and Education, Biological Sciences, and other programs. FOR311 has already initiated an annual laboratory exercise to monitor recruitment and loss of snags on Centennial Forest. Similar opportunities exist for graduate research projects.

The areas used for wildlife-focused research and management activities could also be used for public education. For example, citizens can use the forest to view prescriptions implemented for Mexican spotted owls, or to visit sites used to monitor dynamics of snag recruitment and loss.

Wildlife-related activities such as hunting and wildlife viewing have little or no opportunity to generate revenue directly to Centennial Forest, and we have no interest in promoting these activities, which could under some circumstances conflict with the primary mission of the Centennial Forest.

### 2.4.1 Historic School Forest and Rogers Lake Checkerboard

Near- and long-term research and demonstration projects will enhance our understanding of wildlife and their associated habitat, as well as responses to land management. Adaptive land management will incorporate this increased understanding over time. Of initial interest are to:

- Conduct stand inventories at one sampling unit per 10 acres to identify all MSO restricted habitat on the Centennial Forest.
- Conduct surveys for Mexican spotted owls on all restricted habitat on the Centennial Forest, and on adjacent lands within one mile of our boundary, in cooperation with Coconino National Forest and using protocols approved by the US Fish & Wildlife Service.
- Address the issue of who will pay for the surveys for Mexican spotted owls (mentioned in previous paragraph). These surveys should be conducted at least every other year, and annually in areas where management that might affect the owl is planned for the near future. Thus these are a significant recurring expense.
- Begin the process of writing a Habitat Conservation Plan or developing a mechanism for formal consultation with Fish & Wildlife Service to address impacts of Centennial Forest activities on the Mexican spotted owl. Because this is a complex issue, it is addressed in a separate section on Avoiding adverse impacts on Mexican spotted owl.
- Adopt or adapt US Forest Service policies on control of exotic weeds, and recovery plans for species listed under the federal Endangered Species Act.
- inventory large snags, large logs, yellow pine trees, noxious invasive weeds, rare plants and important browse species (in conjunction with goshawk surveys, below).
- Develop a species list of waterfowl using Rogers Lake during winter and spring, and a species list of passerine birds breeding at Rogers Lake, Dry Lake, and the main canyons on Centennial Forest. In the course of other activities, we will estimate maximum number of pronghorn using the Centennial Forest, and frequency of that use, and share this information with AGFD.
- Partner with AGFD and private landowners to protect, maintain, and enhance the unique ephemeral wetland of Rogers Lake. We could investigate the possibility of a fence to keep vehicles off of the wetland.
- Cooperate with Coconino National Forest and ASLD to regulate fuelwood cutting on the Centennial Forest. Presently, cutting of live Gambel oak trees occurs commonly, although neither CNF nor ASLD issues permits to do so. Holders of US Forest Service fuelwood permits (which allow the permittee to cut dead pines and gather dead and down wood of any species on Forest Service land) are often unaware of the checkerboard ownership pattern; this leads to honest mistakes and makes enforcement difficult. We need to coordinate with the Coconino NF, and at least make sure that permittees have a map that clearly shows CF lands as off-limits.
- Conduct goshawks surveys on all Centennial Forest land (and within one mile), in cooperation with Coconino National Forest and using US Forest Service protocols. Transects will be parallel lines, spaced 270 m apart, with calling points every 300 m, staggered by 150m with respect to adjacent lines. Although we do not intend to follow Forest Service management guidelines for the northern goshawk, we intend, as good land stewards, to avoid impacts to goshawk nesting and foraging areas. As good neighbors to the Coconino National Forest (which must survey for goshawks 1/2 mile beyond any project boundary), we will share our survey data with the Forest.

### 2.4.2 Turkey Hills - Sheep Hill Management Unit

- ASLD may have completed surveys for MSO and goshawks on these 2 sections. If not, we must do so prior to any land management activities that might impact these species.
- Due to presence of sensitive cultural resources, it may not be desirable to promote wildlife viewing or recreational hiking in this zone. However, regular use by responsible citizens might discourage the vandalism, trash-dumping, creation of poorly-placed and eroded trails, and other destructive activities currently prevalent in the area.

### 2.4.3 North Centennial Forest

- The Centennial Forest should conduct surveys for prairie dog colonies, mapping all areas that meet threshold conditions as black-footed ferret habitat as defined by US Fish and Wildlife Service.
- Grasslands within the Centennial Forest are too small to support black-footed ferrets on their own, but could be part of a larger habitat area that includes the adjacent CO Bar Ranch (which also holds the lease for cattle grazing on this Centennial Forest area) and perhaps Coconino National Forest land as well. Both adjacent landowners would likely be receptive toward enhancing habitat for prairie-dogs and ferrets.

## 2.5 Land Management Vision: Cultural Resources

Cultural resources across the various units of the Centennial Forest span a wide variety of environments, time periods, and cultural traditions. These resources provide a cumulative record of human habitation and land use over the past 12,000 years and contain significant scientific information about cultural change, past environments, and human impacts to ecosystems. They are also important to the diverse peoples of Northern Arizona, and help to inform and inspire the multiple groups that claim affiliation with archaeological sites and other types of cultural resources.

We will strive to understand the significance and preserve the integrity of cultural resources on the Centennial Forest through sound research and careful management strategies. Our management goals are to preserve cultural resources in place whenever possible, and to minimize adverse impacts from all activities conducted on Centennial Forest lands. Concurrently, we will pursue appropriate educational and research activities involving that promote our understanding of cultural resources.

**Specific** objectives include:

- Using NAU faculty and students to conduct an inventory of cultural resources in all management units of the Centennial Forest, either by full-coverage survey or a representative sample unit survey
- Assessing the significance and integrity of all resources that are identified, according to the criteria identified in the National Historic Preservation Act (NHPA) and the Arizona Historic Preservation Act (AHPA)
- Minimizing impacts to cultural resources by following the preservation standards, policies, and procedures provided by the NHPA and the AHPA
- Working with State and Federal agencies to develop a regional research design that identifies the potential research contributions of the site types found within the Centennial Forest

- Developing a predictive model of the types and locations of cultural resources likely to be present within the Centennial Forest
- Collaborating with State and Federal Agencies and community groups to create a corps of volunteer "site stewards" to monitor the health of cultural resources, using indicators and standards developed in cooperation with those agencies and groups
- Consulting with regional Indian Tribes and other interested parties to identify the significance and meaning of cultural resources to groups outside the scientific community
- Exploring the feasibility and potential impacts of developing a selected group of cultural resources for public visitation and interpretation
- Utilizing cultural resources as a teaching and training tool for NAU students in archaeology and cultural resource management

## 2.6 Land Management Vision: Recreation Opportunities

The Centennial Forest will provide significant opportunities for **dispersed recreation activities**, particularly environmental education, along with research and educational opportunities for Northern Arizona University students and faculty. We will document the current recreational uses throughout the Centennial Forest and develop a comprehensive plan to better manage that recreation while protecting its significant ecological, geological, and cultural resources. There is also a need to identify potential research and teaching opportunities for students and faculty at the University. All such efforts will be done in partnership with Arizona State Land Department working within and under existing agreements between the University, the State Lands Department and other cooperating State and Federal agencies.
**Specific objectives include:**

- Use NAU students and faculty to conduct a survey to document the current amount and types of recreation use occurring on the Centennial Forest.
- Use NAU students and faculty to complete an inventory of existing roads, trails, special places, and recreation opportunities (using the Recreation Opportunity Spectrum) that currently exist on the Centennial Forest
- Work with the State Lands Department, U.S. Forest Service, and other appropriate land management agencies to develop a comprehensive plan to better manage recreation use of the Centennial Forest
- Explore possible alternatives for lessening the recreation impacts in areas of the Centennial Forest receiving a significant amount of use—specifically the Turkey Hills-Sheep Hill area. Locating trails located away from significant cultural resources in the area, for example, could concentrate recreation impacts and lessen impacts to sensitive areas. There is probably a need to work with local residents who live near and potentially use this area for recreation in a site steward effort—sort of an "adopt an area" idea—to promote environmental stewardship. More neighborhood involvement and presence in the area could lessen the destructive activities in the area such as illegal dumping, driving off-road, and littering. Education and increased signing may help here as well.
- Explore opportunities for environmental education on the Forest, including signs and kiosks at various locations on the Forest and an environmental education camp (see development plan)

- Identify locations on the Forest in particular need of increased signing to educate users about the need for and how to obtain a recreation use permit as well as how to appropriately use the Forest for recreation.
- Utilize the Centennial Forest recreation resources as a teaching tool for School of Forestry students, particularly those in recreation management and interpretation classes.

## 2.7 Land Management Vision: Access and Community Influences

The Centennial Forest will strive to be a **positive community partner** by providing recreation, research and education, and economic opportunities. In order to accomplish this goal, there needs to be clear communication between the Management of Forest Centennial lands and the community in which it resides. Cooperation among the stakeholders is crucial in creating a working community plan for the Centennial Forest. Due to the complexity of land management in urban or multi-jurisdictional rural areas, an inter-governmental approach is necessary. With the lead of Northern Arizona University and the Arizona State Land Department, identified governmental partners include the US Forest Service, Arizona Game and Fish, City of Flagstaff, Coconino County, and the National Park Service. The Centennial Forest is impacted by adjacent land use policy of the above entities.

Educational outreach is a crucial part of being a good neighbor. It is important that the stakeholders and the public recognize the responsibilities and authority of the Arizona State Land Department in this venture while the lands are in trust ownership. The public must also be kept informed of the Centennial Forest's purpose and opportunities because of the reciprocal nature of land use policy. The current and future growth within the community of Flagstaff and the region, and expectations of how the land base should be utilized in the future as well as its current utilization can affect the management of these lands. Conversely, the policies and implementation of such by the Centennial Forest can also affect the adjacent land use and current users of the designated land base. The organized and unorganized publics as well should be used for input as is feasible, especially as some uses may be constrained while others are expanded.

## 2.8 Land Management Vision: Leases, Permits and Utilization

Land Management practices on the Centennial will **honor existing leases and permits**, allowing the continued utilization of the natural resources within the bounds of sound ecosystem-based management. We will work with all holders of leases and permits to arrive and mutually acceptable, if not beneficial, details. **Specific objectives** include:

- Inventory and describe all existing mineral and grazing permits, and commercial leases across the Centennial Forest.
- Develop cooperative research and demonstration agreements that explore the effects of existing permits and leases
- Model potential revenue flow various leases, permits and utilization instruments
- Coordinate timber production activities, when viable, with the Arizona State Land Department consistent with the Timber Management Plan for northern Arizona.

## 2.9 Land Management Vision: Dark Sky and Astronomical Resources

Centennial Forest uses of the land emphasize undeveloped activities and utilization, and thus are generally compatible with preserving the best quality astronomical sites located adjacent and in the Flagstaff region. CF proposals shall be evaluated, whenever relevant, in light of potential impacts on the dark sky resource, and minimization of these impacts shall be sought. Since these impacts will depend not only on types of activities and land uses, but also on specific location relative to observatory facilities, different land uses or levels of mitigation may be required in different areas.