

## 9. Key Resource Management Topics

The following section offers a brief overview of several topics that are highly relevant to current and future forest management. The issues addressed in this section have been discussed throughout the assessment; however, this section offers a more detailed analysis of their potential impact on the socioeconomic environment surrounding the Coconino National Forest (COF). Forest planners from Arizona's six national forests identified these topics as being key to forest management. Although each topic can affect forests in distinct and varied ways and extents, it represents an issue of common concern to national forests and communities throughout the state. Where relevant, issues have been separated to identify their impact on the local, state, and national level.

### 9.1 Forest health

Maintaining and improving overall forest and ecosystem health is an important goal of the USDA Forest Service (USFS). Forest health, however, is a complex and wide-ranging concept, and its exact meaning can be difficult to define. At the national level, the FS has identified four key threats to the health of the nation's forests and grasslands:

- Fire and fuels;
- Invasive species;
- Loss of open space; and
- Unmanaged recreation. (USDA Forest Service 2005j)

Each of these threats, along with the trends associated with them and the implications for managing forest and grassland health, will be considered.

#### *Fire and Fuels*

Nationally, fire on FS lands has been a subject of considerable attention. The Federal Wildland Fire Management Policy estimates that during the pre-industrial period (1500-1800), an average of 145 million acres burned annually in what is now the contiguous United States. Today, an average of about 14 million acres burn on both federal and non-federal lands. Nonetheless, wildland fire regimes and fire-management practices are a major concern for a wide variety of forest stakeholders, including Forest Service staff, recreational users, tribes, and neighboring communities. The White House Healthy Forests initiative describes 190 million acres of national forest land as dangerously susceptible to wildfires, and it states that ponderosa pine density is now fifteen times greater than it was 100 years ago (Office of the President 2002). Federal and state fire-management agencies have reported fires on over more than 5 million acres in five of the last ten fire seasons. During the 2000 fire season, these agencies reported 8,422,237 acres of wildland fire, a record in the more than forty years for which the National Interagency Fire Season has compiled data (NIFC 2005). These numbers pale in comparison to the fires experienced in the western United States before modern fire suppression techniques.

The last few fire seasons have provided several examples that illustrate the costs, financial and otherwise, that can be associated with large wildland fires in the state of Arizona as a whole. The Rodeo-Chediski fire of 2002 spread across 450,000 acres of land, including over 170,000 acres of the Tonto and Apache-Sitgreaves National Forests. The costs associated with the fire surpassed \$40 million (USFS 2003d). Locally, the COF, like any dryland forest or grassland, is no stranger to wildfires. In the summer of 1996, the Horseshoe and Hochderffer Hills fires burned over 16,000 acres of ponderosa pine. In 2003, there were 500 fires in the Coconino NF, up from 330 in 2002 and 447 in 2001 (COF 2003a). On June 9<sup>th</sup>, 2003

alone, there were twenty-three new fires in the region. Among them were the Mormon and Lizard Fires, which covered over 5,000 acres southeast of Flagstaff (Wildfire News 2003). The proximity of national forest land to Phoenix is a major point of contention in fire management. The Phoenix City Fire Department has asserted that “it’s no longer a question of if” Phoenix will burn; “it’s a question of when.” Meanwhile, some forestry experts, including Doc Smith of the NAU school of forestry, accuse such rhetoric of being intentionally polemical and creating a panic in order to suit “the political needs of the time” (Huggard 2001). In any case, many of the areas surrounding the Coconino have been designated as at high risk for wildland fire. According to one Forest Service report, 2,300 acres, or 44% of the project area studied near the Mormon Lake Basin, was rated at moderate-to-high risk for wildfire (USFS 2005a).

Due to this fire activity, Coconino National Forest is at the center of the fuels and fire debate. It appears in the White House’s Healthy Forests Initiative as an example of the interactions of fire and endangered species and is often cited as an example of mechanical fuels reduction projects and the litigation issues surrounding them (Office of the President 2002, Bonnicksen 2000, Suckling 1996, Elperin 2004). The White House’s initiative calls for aggressive thinning projects in the Coconino and places much of the blame for the recent Rodeo-Chediski fire and other fires in the region on the overly dense forests and “nuisance” litigation. Nationally, some researchers echo this claim, blaming no-cut environmentalists for creating a setting for apocalyptic wildfires, while others join environmentalists in arguing that thinning projects that remove larger trees may actually increase the frequency and/or intensity of fires (Segee and Taylor 2002, Omi and Martinson 2002). Other citizen groups in this region argue against what they consider a preoccupation with fuel-reduction projects at the expense of other protection efforts, such as the recent postponement of a project to protect Anderson Mesa (Elperin 2004). At the state level, litigation has undeniably delayed, prevented, or changed some fuel-reduction projects. For example, the Grand Canyon Partnership Assessment Project, which was scuttled by litigation in 2001, was replaced by smaller projects. However, several studies have shown that the impact and scope of litigation on national forest logging plans nationwide has been substantially overstated (Cortner et al. 2003, Carter 2003).

It is important to note that wildland fire has also proven to be a useful management tool in many areas. For example, the wilderness areas associated with the Gila National Forest in New Mexico now make extensive use of fire as a wilderness management tool, utilizing prescribed fire and naturally-ignited “wildland fire use” projects to help meet management objectives on more than 175,000 acres in 2003 (Madrid, pers. comm.).

Wildland fire behavior is determined by several factors, including climate and weather conditions and the type, distribution, and abundance of fuels. Because other elements are difficult or impossible for managers to control, management efforts generally focus on changing the likelihood of ignition and the behavior of fires by modifying fuels. For a fire to ignite and burn, fine fuels must be abundant, and fuel moisture must be low (Wright and Bailey 1982, Wink and Wright 1973). However, the chemical and structural properties of fuels also greatly influence a fire’s behavior. Particularly abundant or combustible fuels result in fires that are more intense and are more likely to show extreme behaviors, such as spotting firewhirls; crowning; and long, fast runs (Pyne 1997). Intense fires can threaten species and landscapes that are better adapted to slow-burning, low-intensity fires, such as some ponderosa pine forests, and extreme fire behavior can make cultural resources and developed areas more difficult to protect. Heavy surface fuels, such as thick needle layers, can result in long-burning, low-intensity fires while dry grasses are consumed very quickly. Understory shrubs and small trees can act as ladders, carrying surface fires into the crowns of trees (Graham, McCaffrey, and Jain 2004). The most common strategies for managing wildland fire are mechanical treatments<sup>1</sup>, controlled fire treatments (used here to include both prescribed and natural-ignition “wildland fire use” fires), and direct suppression of fires.

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<sup>1</sup> Although mechanical treatments and fire use projects generally have the common goal of altering fuels to reduce fire intensity, they are discussed separately here because risks and benefits of each are substantially different. Many policies implicitly or explicitly favor one method over the other.

Managers often also attempt to control human-caused ignitions. As of September 2004, more than 3,260 large, non-prescribed fires had been reported in Arizona and New Mexico. Humans caused 1,308 of these, affecting more than 62,000 acres (CLIMAS 2004, Sept.). Increases in human-ignited fires are likely due at least in part to the increased population of the counties surrounding the national forests (discussed further in the “Unmanaged Recreation” section below). With increased population in Arizona comes an increase in visitors and in potential ignition sources, including campfires, debris burning, and faulty vehicle exhaust (USFS 1999a).

Increased population density also puts added pressure on forest staff to prevent or immediately contain wildland fires. Data for Arizona show that almost 130,000 homes (housing more than 300,000 residents) are at risk from fires (Morehouse 2001). In the wildland-urban interface, where human development meet often highly flammable wildlands, fire on public lands can be a major concern for neighbors on private lands.

The focus of fire policy in Arizona is now shifting from fire suppression to fire management (CNF 2003b). The protection of life and property is always the first priority; however, forests also aim to protect and improve overall ecosystem health through fire-management practices. Nationally, the 2001 Federal Wildland Fire Management Policy states that “the role of wildland fire as an essential ecological process and natural change agent” should be incorporated into the planning process (NIFC 2003). In addition, the more recent Healthy Forests Initiative has also emphasized that the “real solution to catastrophic wildfires is to address their causes by reducing fuel hazards and returning our forests and rangelands to healthy conditions” (Office of the President 2002).

One of the more controversial topics to come out of fire management in recent years is the use of post-fire “salvage” logging to extract some economic gain from burnt areas. Although salvage logging is generally considered to “rescue” any remaining economic value from the affected trees, recent reports have questioned the efficacy and benefits to the national forests of such enterprises. Forest Service documents suggest, for example, that such logging further disrupts the landscape, causes soil erosion, disturbs wildlife, and can actually increase the likelihood of another fire (USFS 2003d, USFS 1999a).

### *Invasive species*

The view held by some that ecosystem health has declined since the arrival of Europeans on the North American continent is linked in large part to a reduction in biodiversity; the falling population numbers of native species; and a concomitant explosion in non-native, invasive species (Ecological Restoration Institute 2005). Native species populations have fallen drastically under pressure from changing land uses and habitat fragmentation, but invasions of non-native species have been identified as the second greatest cause of species extinction (Vitousek et al. 1997). Pimentel, Zuniga, and Morrison (2005) estimate that approximately 50,000 alien-invasive species have been introduced into the United States, costing an estimated \$120 billion per year (including both damages and control efforts). Furthermore, nearly half of the species federally listed as threatened or endangered are in jeopardy primarily because of competition with or predation by non-native species.

Nationwide, invasive species affect forest ecosystems to the detriment of biological diversity, forest health, forest productivity, soil and water quality, and socioeconomic values (Chornesky et al. 2005). Researchers estimate that the roughly 360 non-native insect species that have invaded U.S. forests cost about \$2.1 billion per year in the loss of forest products alone. A similar amount is lost to non-native plant pathogens (Pimentel, Zuniga, and Morrison 2005). The invasions of several species of bark beetles currently pose a serious threat to Arizona’s forest resources.

In the Southwest regional scale, the 2002 bark beetle infestation in Arizona and New Mexico caused significant damage. The infestation was likely the result of a combination of factors, including drought

and high tree density. This outbreak killed millions of Ponderosa pine and piñon trees, and mortality, which reached up to 90% at a few localized sites, was highly visible in some areas. 2003 brought an increase in juniper and Arizona cypress mortality, which was also partially attributed to bark beetle infestations (USFS 2004o). Statewide, the round-headed pine beetle actually decreased its impact area from 11,120 acres in 2002 to 4,530 acres in 2003. Almost all of the 2003 round-headed pine beetle damage occurred within the Coronado National Forest. In the Coconino, primary damage to the forest was caused by Ips beetles which affected over 71,000 acres of ponderosa pine and over 148,000 acres of piñon.

In western deserts, invasive grass species have also resulted in significant ecosystem damage. Annual grasses from Europe were unintentionally introduced through grazing and have changed fire regimes, increasing fire frequency, intensity, and extent (D'Antonio and Vitousek 1992). Likewise, invasions of cheatgrass (*Bromus tectorum*) and Lehman lovegrass (*Eragrostis lehmanniana*) in grassland ecosystems increase fire frequency and intensity. This can be particularly problematic when these invasions occur adjacent to dense forests that are susceptible to wildfire (Chornesky et al. 2005). In the spring and early summer of 2005, above-average winter rains led to significant accumulations of grass and weeds in desert environments, which then carried several large human-ignited fires through desert ecosystems (Johnson 2005, Meahl 2005, Becerra and Pierson 2005). These ecosystems are normally characterized by high concentrations of succulents, which evolved with little or no fire and are poorly adapted to withstand it (D'Antonio and Vitousek 1992). Many non-native plant species also reduce forage quality. Nationally, forage losses due to invasive weed species have been estimated at nearly \$1 billion per year (Pimentel, Zuniga, and Morrison 2005).

On the local level, invasive grass species have been a substantial problem. According to the USFS (2005d), 187,500 acres in the Prescott, Tonto, and Coconino suffer from invasive weeds, such as dalmation toadflax (*Linaria genistifolia*), which pose a substantial threat to native plant and animal populations. Recent decisions include projects intended to reduce the infestation of various species of invasive weeds through 14,000 acres of manual removal, 18,000 acres of mechanical removal, 14,000 acres of cultural removal and revegetation, 16,000 acres of biological removal, and 57,000 acres of herbicidal treatments with limited spray zones established within a mile of communities, recreation and scenic sights, and trailheads (USFS 2005d).

Invasive species threaten a wide variety of forest resources and uses, including both recreation and extractive uses, Chornesky and others (2005) suggest three complementary strategies for controlling non-native species invasions on forested lands:

- Prevention of harmful new introductions by identifying and impeding pathways for invasive species introduction and spread,
- Detection and eradication of invaders that elude prevention, and
- Long-term management of well-established invasive species.

The U.S. Bureau of Entomology and Plant Quarantine, Forest Health Protection, part of the U.S. Department of Agriculture, provides technical assistance on forest health issues and focuses much of its attention on non-native insects, pathogens, and plants (USFS 2005q). Forest Health Protection provides a variety of services aimed at lessening the impacts of these invasive species, including management, monitoring, technology development, pesticide use guidance, and technical assistance programs. A joint project of the University of Georgia and the USDA provides detailed information on a wide variety of invasive weeds, diseases, insects, and other species (ISSG 2005). The Forest Service has also developed the National Strategy and Implementation Plan for Invasive Species Management, which aims to “reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species across all landscapes and ownerships” (USFS 2004o).

### *Loss of Open Space*

Changing patterns in demography and land use (discussed in more detail in the following section) are leading to a loss of open spaces in U.S. landscapes. In the western United States, “exurbanization,” the shift of populations to semi-rural areas outside suburban areas, is a major contributor to this phenomenon. Much of the rapid growth currently sweeping the Rocky Mountain States is occurring outside of metropolitan areas on land that was previously used for grazing, agriculture, private forestry, and/or recreation (Esparza and Carruthers 2000). The USFS has identified this fragmentation of forests and grasslands as a major threat to ecosystem health (USFS 2004n). Vitousek and others (1997) describe land transformation (including transformation of natural ecosystems to row-crop agriculture, urban and industrial areas, and pastureland) as, “the primary driving force in the loss of biological diversity worldwide.”

The negative effects of these changes are wide ranging and also include local and global climate changes, air pollution, sediment and nutrient runoff, the destruction of aquatic ecosystems, and a reduction in opportunities for outdoor recreation (Vitousek et al. 1997). The FS notes that, although the loss of open space through residential and commercial development generally increases land values and taxes, it also increases the cost of providing social services to local communities and undermines traditional and rural land uses (USFS 2004n).

A study of exurbanization in Cochise County, Arizona described how city- and county-level planning can inadvertently encourage exurban development by increasing the cost and complexity of residential development within the city limits and by promoting low-density development through zoning designations (Esparza and Carruthers 2000).

### *Increased Recreation at National Forests*

In its Agricultural Fact Book, the USDA identifies the Forest Service as supplying more recreational activities than any other federal agency. Given a rising involvement in wilderness recreation, the continuing availability of such opportunities is increasingly important (Cordell et al. 1999). Sixty years ago, public use of the national forests in Arizona was limited, with only 600,000 visitor days. Twenty years ago, however, visitor days had increased to nearly 15 million, making the national forests one of the main recreational resources in Arizona and in the Southwest in general (Baker et al. 1988). Today, the National Forest System is an impressive source of outdoor recreation, education, and involvement. Nationwide, more than 200 million recreational visits are logged annually, and the national forests provide 50% of the nation’s forested trail area and 60% of the skiing opportunities (USDA 2002). In Coconino alone, there are between 1.7 million-1.9 million visits each year to the national forest itself and between 100,000-300,000 wilderness visits, making tourism one of the single most vital economic factors to the communities surrounding the forest (Kocis et al. 2001b). As a result, tourism has become one of the single most vital economic factors to the communities surrounding the forest. In 1996, almost half of all hunters used public lands, and one-third of their hunting days occurred entirely or in part on public lands (Flather, Brady, and Knowles 1999). In addition, activities such as rock climbing have greatly increased in popularity although the inherent risks have caused officials to consider special use fees to cover added ranger responsibilities surrounding climbing-related injuries (Cordell et al. 1999). In the area surrounding the COF, tourism plays an important economic role in Coconino County, with Grand Canyon National Park, Oak Creek Canyon, Lake Powell, Sunset Crater, Walnut Canyon, and Wupatki also drawing large numbers of tourists (Coconino 2003).

In Arizona, access to recreational activities on federal- and state-protected land is important and valuable. Over the past half-century, the demand for such outdoor experiences has grown tremendously nationwide. This change can be attributed to several trends, including an increase in leisure time and discretionary income and a greater appreciation for nature in response to growing urbanization (Clawson 1985). About

45% of registered Arizona voters frequently or occasionally go hiking while 40% go picnicking or animal watching. Whether fishing, off-roading, boating, hunting, visiting archeological sites, mountain biking, or horse riding, it is clear that a substantial portion of Arizona residents make use of the National Forest System at one point or another (Merrill 1998). For example, 93% of respondents in a Forest Service report on the Heber-Overgaard area of the Apache-Sitgreaves National Forests agreed that the availability of public lands for recreational activity was at least somewhat important, and nearly all of the respondents felt hiking should be allowed within reasonable parameters. 87% of the respondents even felt that off-road vehicles should have access to forests with only limited restrictions (USFS 1999a).

The explosive growth of recreational use presents challenges to managers even as the public receives increasing benefits from its forests and grasslands. The FS has acknowledged the increasing pressure on forest resources, particularly in the Rocky Mountain and Southwest regions. Similarly, it is currently emphasizing the need to effectively manage recreation, especially the use of off-highway vehicles (OHVs) (see Section 9.3, Forest Access and Travel). With the growing trend toward exurbanization, changing land patterns may threaten easy access to those environmental recourses of escaping urban stress and enjoying the serenity of a natural environment which are some of the foremost reasons for forest usage (Peart 1995, Knopf 1987).

Given the rapid growth of Arizona's population, overcrowding may be an increasing challenge for the COF. While, according to NVUM data, 58% of visitors interviewed stated that there appeared to be hardly anyone else present during wilderness visits, the same survey shows that 56% of those interviewed considered overcrowding on developed overnight sites to be a problem in the Coconino, one of the worse proportions for Arizona's national forests (Kocis et al. 2001b).

A related issue that has drawn some attention recently is the use of recreation fees for public lands. Some users feel that such fees amount to double taxation, adding costs on top of the money donated in taxes, and that these fees discourage lower-income individuals from accessing the park. These arguments echo the ideas of Frederick Law Olmstead, one of the designers of New York's Central Park and an instrumental voice in the formation of the National Park system. For Olmstead, public open spaces oiled the gears of democracy by bringing disparate classes together. Nevertheless, fees remain relatively low, and studies have shown that the primary cost-incurring activities involved with visits to public lands are those related to travel and lodging (Grewell 2004). However, given that in 2001, nearly 94% of the wilderness visitors to the Coconino were Caucasian (in a state with a 25% non-white population), the question of how fees might affect diversity on the public lands system merits some discussion (Kocis et al. 2001b).

Locally, in addition to other expansions and construction, renovations to the Snowbowl ski area in the San Francisco Peaks have also created significant public relations challenges. The controversy surrounding this issue has led opponents to develop several websites, sell bumper stickers, and even film a documentary. The plan to add new ski trails and to use reclaimed water to create snow has led to protests both by Native American groups, for whom the peaks are of great religious significance, and by some scientists that question the safety of the procedure. Although the case of *Lyng v. Northwest Indian Cemetery Protective Association* effectively bars Native American groups from using the first amendment to curb development on spiritual sites, the resulting objections can draw unwanted negative attention to the area (Yablon 2004). Although the reclaimed water used at the site meets Safe Drinking Water Act standards, some chemicals remain behind in reclaimed water. The potential long-term environmental and health effects of those chemicals to humans are largely unknown, although humans can come into contact with these chemicals either through direct contact or through runoff into water sources (Phillips et al. 2004, George et al. 2004). The Snowbowl ski area currently operates under a special use permit provided to it by the Forest Service as is common for skiing areas on western public lands.

## 9.2 Land and water resources

Previous sections have provided substantial information on recent demographic changes within the area surrounding Coconino NF. Here, the focus is not on the quantitative nature of demographic change but on the qualitative characteristics of change likely to affect forest management.

Arizona is among the fastest growing states. The population in Arizona increased by more than a factor of four over the 1950-1995 period, and the demographic data within this report show that this trend exhibits no immediate signs of slowing. Some researchers predict another doubling in population between now and 2040 (Peart 1995). Also, older Americans, an increasing part of the population (one in eight people in the U.S. is now over 65 as opposed to one in twenty-five 100 years ago), are moving to the warmer climates of the south and west (Alig et al. 2003). As noted throughout this report, Arizona is also becoming increasingly “exurban” (that is, residences are spreading further from metropolitan areas and becoming more widely spaced), and the popularity of many outdoor recreation activities continues to rise. Previous descriptions in this assessment have shown how, as a result of these developments, many forests are seeing a growing trend toward recreational use and “ecosystem services” (i.e., the management of public lands to provide services such as improved water quality, wildlife habitat, and clean air to surrounding communities) and away from extractive uses such as mining, logging, and grazing. Availability of land and water is a growing concern for Arizona’s rapidly expanding urban areas. Although national forests in the state are affected by urban growth to different extents, each will need to consider its role as a provider of open space and healthy watersheds. Livestock grazing, changes involving state trust lands, the increased utilization of forests’ water resources, and roadless area rules were identified by forest planners as points of particular interest.

### *Grazing*

Livestock grazing has a long history in Arizona. The prominence of grazing in this area dates back to the middle of the 18<sup>th</sup> century, when Spanish explorers transported livestock into the region by way of Mexico (Allen 1989). Formal ranching began in the late 1800s following the Civil War and the widespread suppression of the local indigenous populations (Sheridan 1995). The U.S. government’s primary interest was in land acquisition until the 1850s. The distribution of lands to Anglo settlers began in earnest with the Homestead Act of 1862. Over the century following the Civil War (1865-1965), there was a 600% increase in the number of cattle in the western states. However, this transition was not without interruption. For example, the 1880s saw an immense boom in livestock numbers. Nearly a million head of cattle were reported in Arizona by the end of that decade, up from about 38,000 in 1870. However, a combination of environmental and economic pressures soon decimated the herds (and the range, which was devastatingly overgrazed by the mid-1890s), and by the end of that century, an estimated 50-75% of southern Arizona’s cattle had perished (Sheridan 1995).

Nationally, in 1906, the Forest Service implemented the practice of collecting fees for grazing private livestock on public land. The amount of FS land devoted to livestock grazing has been stable over the past three decades, as has been the amount of BLM land (USFS 2000a). However, some studies have suggested that changes in land use will result in a decrease of grazing land in the Pacific and Rocky Mountain Assessment Regions (Mitchell 2000). At present, nearly 167 million acres of BLM land and 95 million acres of Forest Service land are allotted to fee-based grazing rights, the latter accounting for 65% of the entire National Forest System. Livestock graze over 90% of federal lands in the eleven western states (Carter 2003). The forage grazed on this land accounts for about 2% of the beef-cattle feed in the continental U.S. and financially supports one-tenth of western livestock producers, whose grazing fees continue to be charged based on the formula initiated by the Public Rangelands Improvement Act of 1978 (PRIA) (Cody 2001). The grazing leases provided by the Forest Service account for nearly one-quarter of the grazing land utilized by Arizona ranchers, and most Arizona ranching operations rely on one or more federal or state grazing permits (Ruyle et al. 2000).

The PRIA began the fee formula for the FS and the BLM on an experimental basis, but following continuing presidential and congressional support, it has remained the standard. However, grazing fees have become controversial, in part because fees have not kept pace with comparable private market rates. In 2002, for example, the grazing fee remained \$1.35 per AUM<sup>2</sup> on federal land while the USDA estimated the average rate for grazing leases on non-irrigated private land among sixteen western states at \$13.50 per AUM (NASS 2003). Some citizen groups assert that this leads to disproportionate financial output by the Forest Service in the interests of grazing (Coalition 2001). In Arizona, for example, conservation groups note that the Forest Service recently spent nearly \$250,000 to establish and maintain cattle fences and borders for land that generates only \$7,000 per year in grazing revenue as part of an attempt to protect Apache Trout and other threatened fish in livestock-impacted watersheds (Wolff 1999). Many groups also argue that livestock ranching interferes with other uses of the national forests

The National Forest System contains much of the summer range and a portion of the year-round grazing in the area, and as such, regional administrators help determine the success of southwestern livestock industries. However, ecological impacts of ranching, including the persecution of “problem animals,” the alteration of fire regimes, impacts to water supplies and riparian areas, introduction of exotic weeds, and the construction of fences and roads, can bring it into conflict with other uses (Freilich et al. 2003). Some argue that a balanced relationship between livestock grazers, environmentalists, and the Forest Service is important, even critical, given the continuing decline of grassland ecosystems, even critical (Baker et al. 1988).

Many proponents of ranching point to the social and economic benefits of rural lifestyles, arguing, for example, that “the best way to preserve the open spaces, arid ecosystems, and diverse biota of the Southwest is to keep rural people on the land” (Brown and McDonald 1995). Thus, ranching on public and private lands may also be seen as a viable method of limiting urban sprawl and promoting the economic independence and cultural uniqueness of rural communities.

### *State Trust land reform*

The practice of allocating public lands for various beneficiaries in Arizona dates back to the founding of the territory in 1863. The current system of managing these lands, referred to as State Trust lands, was established with the Arizona State Land Department (AZSLD) in 1915. Since that time, the department has worked actively to manage these lands to help fund schools and other public institutions. In addition to original allotments granted by the federal government through Territorial and State Enabling Acts, the State Selection Board was allowed to select various lands throughout Arizona sufficient to ensure future financial support for selected beneficiaries. The selection of lands for state acquisition was completed in 1982 although most land selections were made between 1915 and 1960. Federal laws prohibited acquiring mineral lands or agricultural areas previously claimed by homesteaders, so the Selection Board chose lands with the greatest grazing potential. As a result, the majority of land selected between 1915 and 1960 was in central and southeastern Arizona with some additional “checkerboard” parcels near railroads in the north central portion of the state. Since that time, land exchanges have led to relocation of limited trust lands in western desert areas toward the region surrounding Phoenix and Tucson as well as western Yavapai County (AZSLD 2005).

Since its inception, the State Land Department has been granted authority over all trust lands as well as the natural products they provide. This authority over trust land is central to the AZSLD’s primary mission of maximizing revenues for its beneficiaries, a role that distinguishes it from other agencies charged with management of public lands (national parks, national forests, state parks, and the like). As of

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<sup>2</sup> One AUM is defined as the amount of forage required by an animal unit (the equivalent of one 1,000 pound cow and her suckling calf) for a one-month period. Thus, the total number of AUMs is equal to the number of animal units multiplied by the number of months they are on the range.

2005, the AZSLD managed land holdings for fourteen beneficiaries, the most prominent of which is the K-12 public school system. The public schools currently hold 87.4% of State Trust lands. The vast majority of Arizona trust lands currently are intended solely for livestock grazing. However, the Urban Lands Act, passed by the state legislature in 1981, has allowed the State Land Department to capitalize on the increased value of trust lands surrounding the state's rapidly growing municipalities. As a result, the Land Department's urban lands lease and sale program has become the largest revenue producer for the trust (AZSLD 2005).

Pressure for reform of the State Trust land system has been fed in recent decades by a relative scarcity of private developable land in areas that are continuing to experience massive population growth. Although various kinds of reforms have been proposed, the variety of stakeholders involved makes resolution a challenge. The competing interests involved include city and town governments and political lobbies representing educators, environmentalists, grazing interests, and homebuilders. Several cities throughout the state are striving to work with builders in order to ensure a sufficient supply of land for future housing. At the same time, educators would like to collect as much money as possible from the sale of trust lands in order to supplement limited financial support from the state legislature. Finally, environmentalists and ranchers have an interest in preserving lands for their conservation value and existing grazing rights. Despite continued efforts to reach a compromise among these interests, a number of proposed reform plans have thus far failed to pass from committee in the Arizona State Legislature (Nintzel 2005, Davis 2004).

At issue is the process by which the State Land Department takes advantage of increased land values for educational funding while still preserving sensitive areas for conservation in the face of increasing urbanization. Policy makers suggest that the impasse over proposed reforms for the State Trust Land System can be broken down into the following key issues, all of which have been viewed as "deal breakers" by one or more of the interested parties: 1) the amount of land available to be set aside for conservation; 2) open, competitive auctioning for grazing leases; 3) federal and state land exchanges; and 4) the composition of the State Trust Land Board (Sherwood and McKinnon 2005, Nintzel 2005, Riske 2005).

Legislators have balked at proposals favored by organizations such as the Sonoran Institute and Grand Canyon Trust that call for protection of nearly 700,000 of the state's 9.3 million acres of Trust Land. Meanwhile, the Arizona Preserve Initiative, a measure that would allow the state to match payments from local jurisdictions to buy state land that qualified for open-space preservation, has been delayed by legal challenges to its constitutionality. Similarly, legal court challenges to State Trust Land reform have been posed by groups seeking to overturn the Arizona Supreme Court's decision in 2001 that allows non-ranchers to bid on state grazing leases as well as a 1990 Supreme Court ruling which prohibits the state from swapping parcels with federal agencies and/or private speculators. Finally, comprehensive reform of Arizona's State Trust Land system has also been held up by the education lobby's insistence that any reforms should be approved by a newly composed Board of Trustees charged with overseeing the management and disposal of trust lands (Sherwood 2005, Nintzel 2004).

These and other challenges have been addressed by various proposals for reform submitted by state lawmakers. As recently as October 2004, a coalition seeking the overhaul of state land management was "pronounced dead" after the facilitator resigned in the wake of failed attempts to pass a measure through the legislature. Still, Governor Napolitano, along with a number of state senators and representatives, remains committed to Trust land reform and aims to present voters with a reform package by the 2006 general election. Whatever the outcome, it should be noted that the ultimate resolution of these issues will likely have a significant impact on national forests in Arizona given the extent and value of State Trust lands in close proximity to forest boundaries (Davis 2004, Riske 2005). More information on the management of State Trust Lands by the Arizona State Land Department is available online at <http://www.land.state.az.us/>.

## *Water*

The U.S. uses a lot of water, and the primary uses are not always obvious to the general public. Even though per capita public consumption of water resources has increased by 400% over the past century, less than one-tenth of total freshwater removal is utilized in the areas most often considered under “primary water use”: domestic and private use. The judicious use of water resources is particularly important in the West, and water is an immediate and everyday concern to Arizona residents. The National Forest System in the state is central to the question of water resources. Although USFS lands account for only 14% of the total land area, those lands contain 40% of the region’s water resources (Baker et al. 1988). In fact, national forests and grasslands function as the largest provider of water in the continental U.S., containing nearly 10 million acres of wetland and riparian areas and the headwaters of 15% of the nation’s supply of water. These resources, valued at billions of dollars, supply water to more than 60 million people and provide opportunities for recreation, preservation, and employment (Schuster and Krebs 2003).

Regionally, below-average precipitation over the past several years has once again brought water to the forefront of natural resource management concerns. According to the U.S. Geological Survey, the period following 1999 is the driest in the hundred years that the Colorado River has been monitored. That river supplies 25 million people in seven states with water (USGS 2004, CRWUA 2005, Pontius 1997). In Arizona in particular, low rainfall has led to periodic drops in water levels in nearly all the primary reservoirs. Statewide, although Lake Mohave and Lake Havasu raised their levels by 1% and 3% respectively over the second half of 2004, other reservoirs dropped precipitously. The Salt River system dropped 8% against the maximum storage level, and Lyman Reservoir dropped 16%. By early 2005, both Mohave and Havasu had already returned to the previous, lower levels. Above average rains last winter, however, have had a profound effect upon Arizona’s primary reservoirs with four at over 90% capacity and nearly all at higher levels than the year before. One of the watersheds closest to the Coconino, the Verde River System, was up to 99% of capacity by May of 2005. The capricious nature of Southwest precipitation is one of the aspects that make management of water resources particularly difficult in this region (CLIMAS, September 2004; CLIMAS, February 2005; CLIMAS, May 2005).

Much of the previous years’ water worries can be attributed to below-average precipitation starting in October 2003. Below-average snow-pack in Payson, Arizona, has caused that community, and many others like it, to implement programs aimed at conserving water. The Salt River Project Board of Directors, which instituted cutbacks in residential, agricultural, and municipal use for 2005, has taken similar precautions. That was the third straight year such methods were implemented (CLIMAS, September 2004; CLIMAS, February 2005).

Similarly, water providers in the Pinetop-Lakeside region of Navajo County are engaged in aggressive planning on how to meet demand through 2020 and beyond. Meanwhile, at the state level, the creation of groundwater Active Management Areas (AMAs) requires proof of 100-year water viability before any new development can begin (Pinetop-Lakeside 2004).

These requirements have led some communities with adequate water supplies to predict increased growth as developers search for areas with enough water to meet AMA requirements. Statewide, other longstanding water protection initiatives are suffering setbacks. The Colorado River Compact of 1922, for example, was meant to limit withdrawals from the Upper Colorado Basin to the lower basin states, including Arizona, to 8.23 million acre-feet (maf); however, recent deliveries have been about 10 maf, well above the requirements of the compact (Brown 1999).

While the government has contracted research organizations to investigate the possibilities of developing a water pipe across the Coconino Plateau which would transport water from Lake Powell and the Grand

Canyon Dam as far south as Phoenix, these plans have not translated into any large-scale action to date (Heffernon and Muro 2001).

Watershed pollution also remains a concern in the region. In 1993, Pinto Creek suffered environmental damage from a breach in containment at a tailing waste levee. Acid drainage and other chemical byproducts of the mining industry also pose dangers to recreational and fishing activities on public lands (Peart 1995). Considering the value of water though, continuing such management activities while working in partnership with tribal and other nongovernmental agencies is, in the words of Schuster and Krebs (2003), “simply good business.”

### **9.3 Forest access and travel**

Earlier chapters discussed forest access and travel, focusing on the transportation characteristics of communities surrounding the Coconino National Forest. This section provides a detailed assessment of recent interpretations of the Roadless Rule and current trends in OHV use—two internal access issues that are of particular concern to many forest planners and that are likely to have a significant impact on future forest planning.

#### *Roadless areas in the National Forests*

The larger roadless areas in national forests have long received different treatment from more developed areas. Through Roadless Area Review and Evaluation (RARE) studies, these areas have been inventoried and their wilderness characteristics considered for potential designation as wilderness under the Wilderness Act of 1964 (Baldwin 2004). The National Wilderness Preservation System is comprised of federal lands “where the earth and its community of life are untrammeled by man, where man himself is a visitor and does not remain” (16 USC 1131 et seq.). Wilderness areas are designated only by Congress and are generally protected from commercial enterprises, road construction, mechanical vehicles, and structural development.

Roadless areas provide a variety of social and ecological benefits, and these unfragmented lands have become even more important as unprotected areas are increasingly developed and converted to urban uses. Among other benefits, they provide clean sources of drinking water and help prevent downstream flooding, protect threatened and endangered species, provide a wide variety of recreation opportunities, and serve as barriers against invasions of non-native species. The Coconino National Forest includes approximately 50,000 acres of inventoried roadless areas (IRAs) (USFS 2001c).

In 2001, the FS published a final rule that prohibited several activities in IRAs. These activities were prohibited because they threatened to diminish the areas’ suitability as designated wilderness (USFS 2001b). With significant exceptions, road construction and reconstruction and timber cutting were prohibited in IRAs. Implementation of this rule was administratively delayed, then enjoined, by two separate Federal District Courts and remains enjoined under appeal (Baldwin 2004). Subsequently, a new rule was adopted by the USDA on May 5<sup>th</sup>, 2005 that provides individual states with significant flexibility in managing IRAs by allowing governors to petition the Secretary of Agriculture to create special, state-specific rules (USFS 2004g). According to a report from the nonpartisan Congressional Research Service, the new rule suggests that IRAs “would be presumed available for a variety of uses, including timber harvests, subject to unit-by-unit planning processes” (Baldwin 2004).

#### *Off Highway Vehicle (OHV) access*

Historically, recreational use of the forests was non-motorized except on major forest roads. Beginning in the 1980s, however, the use of motorized recreational vehicles significantly increased (USFS 1999a). Currently, 1.1 million Arizonans, slightly more than 20% of the state’s residents, identify themselves as

motorized trail users (USFS 2003a, Arizona State Parks 2004). The popularity of OHVs creates yet another challenge to the FS's commitment towards balancing recreational use and forest health. OHV use can provide substantial economic advantages to the surrounding communities. According to Silberman (2003), OHV users spent a combined \$518.8 million in 2002 in Coconino, Yavapai, and Gila Counties, representing \$23.9 million in state tax revenue. However, a number of studies have shown that OHV use also poses a threat to resources through trail deterioration, vegetation damage, reduced air and water quality, noise pollution, wildlife disruption, and social conflicts arising between different groups of recreational users such as hikers or bikers.

This, combined with the increased problems caused by illegal use, makes managing OHVs a topic of importance to the forests (Stokowski and LaPointe 2000, Bluewater Network 1999). In response, the COF and four other Arizona national forests initiated a five-forest amendment for OHV travel. Still in the early stages at the time of this assessment, the Apache-Sitgreaves, Coconino, Kaibab, Prescott, and Tonto National Forests adopted a Draft Environmental Impact Statement (DEIS) that proposes limitations and/or restrictions on cross-country travel by OHV users on lands managed by the five forests. Several issues need to be resolved before these amendments can be adopted into existing forest plans, among them the feasibility of enforcing new OHV restrictions and the right of entry for individuals into certain areas for the purposes of cultural practices, fuelwood gathering, or retrieval of big game (USFS 2003a, USFS 2003c, Arizona State Parks 2004). Only the Coronado NF is not a party to the proposed amendment, having previously established forest rules regarding cross-country travel. Contrary to existing regulations in the COF and other forests in Arizona, areas within the Coronado are considered closed unless otherwise posted. This has effectively prohibited the cross-country travel by OHVs that the five-forest amendment currently seeks to address.

A review of the FS-wide policy regarding OHV travel is also taking place at the national level. The draft national OHV policy, published in July 2004, would require forests to designate a system of roads and trails for OHV use. This process will likely require a considerable amount of time, personnel, and financial resources to complete (Roth, pers. comm.).

## 10. Summary of Key Findings and Recommendations

The communities surrounding the Coconino National Forest (COF) have undergone substantial social and economic changes over the last twenty years. The purpose of this assessment has been to illustrate some of the more dramatic trends in key indicators and discuss their likely implications for future forest planning and management.

Among the most noteworthy trends in the area of assessment is a significant increase in population over the past two decades. Data show that overall population within the three counties surrounding the COF increased by over eighty-five percent between 1980 and 2000 with the strongest growth occurring in Yavapai County. Within this overall increase, growth in the retirement-age population and an upsurge in individuals of multiple race and Hispanic origin were particularly strong. Along with increases in population, the area witnessed a substantial growth in housing, including homes intended for seasonal use. Median home values in the area surrounding the COF also accelerated much more quickly than was average for the state of Arizona over the same period. Together, these trends warrant careful consideration by forest planners. Ultimately, a larger and more diverse population suggests not only an increased number of potential forest users but also a change in the level and nature of interaction between the COF and surrounding communities.

The economy of northern Arizona is also likely to have a substantial impact on future planning and management of the COF. Data suggest that economic growth in the region has been relatively strong, supported in part by strong gains in total part- and full-time employment in Yavapai County. The most significant economic gains between 1990 and 2000 were reported for the construction, wholesale trade, and finance and real estate sectors. Despite significant increases in per capita and family income and decreasing rates of poverty, data show that both Coconino and Gila Counties remained economically limited when compared to statewide figures over the same period. Meanwhile, recent indicators of dependence on natural resources have shown mixed results. As a whole, the area of assessment experienced a substantial decline in income from both wood and special products and a relatively strong increase in tourism employment between 1990 and 2000. Although activities such as ranching and timber harvesting continue to play an important role in rural areas, recent years have seen a continued shift away from extractive industries and toward a regional economy that is increasingly dependent on the construction, real estate, and service sectors supporting growing urban populations. When combined with ongoing demographic changes, such factors are likely to have a direct impact on the COF's role within the local and state economy.

A review of county comprehensive plans and long-range policies has demonstrated the importance of both travel patterns and land use characteristics surrounding the COF. Though road conditions have generally improved over the last several decades, research shows that expansion of regional road networks has not kept pace with travel demands arising as a result of population and industry growth. Furthermore, previous transportation planning has not always been implemented in a way that supports long-range land use plans. Such plans reveal that the preservation of open space, the sustainable use of natural resources, and the use of public lands are of growing importance to regional planning authorities, government agencies, environmental advocates, and community residents. Increasing land values, the cost of infrastructure development, and limited water supplies are among the numerous factors that have made policy formation increasingly contentious in recent decades. The COF has an opportunity to play an important role in the resolution of current and future transportation and land use issues by promoting sustainable regional planning policies, informing local stakeholders of the environmental and economic impacts of transportation and land use alternatives, and effectively involving surrounding communities in forest planning and management.

Concurrent with trends in the regional economy, there has been a measurable shift away from extractive uses of national forests. This trend is supported by national surveys showing continued declines in timber harvesting as well as recent data on the Coconino National Forest that suggest a ninety percent decrease

in timber harvesting on forest lands between 1990 and 2000. These same reports point toward a substantial increase in recreational uses of national forests in general and the COF in particular. Data suggest that a significant increase in the use of OHVs is a primary reason for the Forest Service's growing concern over unmanaged recreation. These trends are consistent with the recent expansion of communities with high levels of natural resource amenities and signal a shift in the perceived role of forest lands. The COF has the opportunity to incorporate these data on changing forest users and uses into future forest plan revisions and management priorities.

Although the incorporation of "special places" into forest management plans is a relatively new phenomenon, the COF has designated hundreds of natural, cultural, and recreation sites within forest boundaries. Forest archeologists and recreation staff have also made considerable progress in identifying a number of areas throughout northern Arizona that are considered special by Native American tribes, descendents of early settlers, and wilderness enthusiasts. Recent developments such as the proposed expansion of the Arizona Snowbowl have highlighted the importance of "special places" as a key factor in forest planning and community relations. In the future, the COF should continue to seek public input in identifying special places and planning for their protection.

Regional trends and Forest Service planning regulations have influenced the relationships between the COF and surrounding communities. In particular, the protection of wildlife, prevention of forest fire, sustainable management of area watersheds, and the provision of land use policy have involved a diverse array of stakeholders. In recent years, growing attention has been paid to these issues given the general public's expectation for adequate participation in decisions affecting public land management. Although such relationships are inherently unique and dynamic, specific frameworks for monitoring and improving community-forest interaction may aid future COF management objectives.

Finally, data suggest that a number of natural resource issues will continue to influence future management alternatives of the Coconino National Forest. The control of invasive species, management of fire and fuels, preservation of open space, and protection of regional biodiversity each carries important implications for future forest plans. Although an exhaustive analysis of these issues is beyond the scope of this assessment, research shows that each will be significantly impacted by ongoing socioeconomic trends.

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## Appendix A. Industry Sectors for IMPLAN Data Analysis

<b>Income from wood products and processing</b>	
<b>NAICS Sector</b>	
133	Logging camps and logging contractors
134	Sawmills and planing mills
135	Hardwood dimension and flooring mills
136	Special product sawmills
137	Millwork
138	Wood kitchen cabinets
139	Veneer and plywood
140	Structural wood members
141	Wood containers
142	Wood pallets and skids
144	Prefabricated wood buildings
145	Wood preserving
146	Reconstituted wood products
147	Wood products, N.E.C.
148	Wood household furniture
152	Wood T.V. and radio cabinets
154	Wood office furniture
157	Wood partitions and fixtures
161	Pulp mills
162	Paper Mills-Except Building Paper
163	Paperboard Mills
164	Paperboard containers and boxes
165	Paper Coated & Laminated Packaging
166	Paper Coated & Laminated N.E.C.
168	Bags-Paper
169	Die-Cut paper and Board
170	Sanitary Paper Products
171	Envelopes
172	Stationary Products
173	Converted Paper Products N.E.C.

<b>Income from special forest products and processing</b>	
<b>NAICS Sector</b>	
22	Forest products
24	Forestry products
26	Agricultural-Forestry-Fishery Services

<b>Tourism employment*</b>	
<b>NAICS Sector</b>	
<b>Retail</b>	
449	General Merchandise Stores
450	Food Stores
451	Automotive Dealers and Service Stations
452	Apparel & Accessory Stores
455	Miscellaneous Retail
<b>Restaurant / Bar</b>	
454	Eating and drinking
<b>Lodging</b>	
463	Hotels and lodging places
477	Automobile Rental and Leasing
<b>Amusements</b>	
486	Commercial Sports Except Racing
487	Racing and Track Operations
488	Amusement and Recreation Services
489	Membership Sports and Recreation Clubs

\* Discounted according to the Travel Industry Association of America Tourism Economic Impact Model (TEIM). TEIM attributes the following percentages of gross sales to tourism: lodging (95%), restaurant/bar (23.62%), retail (10.91%), and amusements (6.43%).

Source: Arizona Tourism Statistical Report 2003, Arizona Office of Tourism (AZOT)

## Appendix B. Indirect Economic Effects of Forest-Related Products in the Coconino National Forest

### Output, Value Added and Employment

July 26, 2005

Base Year: 2002

Industry	Industry		Employee	Proprietor	Other Property	Indirect	Total
	Output*	Employment	Compensation*	Income*	Income*	Business Tax*	Value Added*
1 11 Ag, Forestry, Fish & Hunting	167.143	1,451.281	11.568	3.112	9.775	4.641	29.096
19 21 Mining	304.561	1,865.376	78.867	8.108	63.958	13.379	164.313
30 22 Utilities	87.947	371.688	18.739	0.991	19.702	6.658	46.089
33 23 Construction	1,361.011	12,671.807	349.222	115.461	53.657	6.164	524.505
46 31-33 Manufacturing	2,154.233	6,881.290	290.532	34.240	138.950	20.749	484.470
390 42 Wholesale Trade	345.692	3,182.187	130.792	7.516	54.363	57.609	250.280
391 48-49 Transportation & Warehousing	406.780	3,900.876	151.158	20.023	33.302	11.597	216.081
401 44-45 Retail trade	982.855	18,169.173	389.430	60.332	146.770	144.149	740.680
413 51 Information	221.810	1,341.418	44.436	6.172	38.084	7.034	95.725
425 52 Finance & insurance	320.631	2,515.640	80.054	8.471	82.280	6.359	177.164
431 53 Real estate & rental	459.229	5,540.180	49.961	36.711	170.610	41.643	298.926
437 54 Professional- scientific & tech svcs	313.040	4,309.304	108.469	80.559	31.285	4.161	224.473
451 55 Management of companies	17.246	171.037	7.384	0.311	3.433	0.182	11.310
452 56 Administrative & waste services	226.966	5,106.904	82.645	14.138	18.500	4.203	119.486
461 61 Educational svcs	92.604	2,344.353	50.144	-0.133	1.297	0.546	51.855
464 62 Health & social services	1,061.913	15,317.661	491.489	60.006	58.866	8.025	618.386
475 71 Arts- entertainment & recreation	165.886	3,047.691	51.234	7.253	17.680	9.891	86.057
479 72 Accommodation & food services	719.636	18,122.482	243.077	14.765	69.819	42.631	370.293
482 81 Other services	409.607	8,035.229	141.486	37.270	10.186	5.385	194.327
495 92 Government & non NAICs	2,345.116	26,141.052	1,173.217	0.000	805.932	90.452	2,069.602
Totals	12,163.906	140,486.626	3,943.906	515.306	1,828.448	485.458	6,773.118

\*Millions of dollars