

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 Tonto National Forest. 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, they represent issues of common concern to national forests and communities throughout the state.

9.1 Forest health

Maintaining and improving overall forest and ecosystem health is an important goal of the USDA Forest Service (USFS). However, forest health 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, namely:

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

We will consider each of these threats, the trends associated with them, and the implications for managing forest and grassland health.

Fire and Fuels

Wildland fire in national forests is of central importance to forest planning today. Nationally, 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 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, including 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.

Like any dryland forest or grassland, the Tonto National Forest is no stranger to wildfires. 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. Of this acreage, approximately 10,711 acres were on the Pleasant Valley Ranger District of the TNF affecting ponderosa pine stands which burned with high severity. Overall costs associated with the fire surpassed \$40 million (USFS 2003d). In addition to the harm done to fish and tree populations, the Saguaro cacti population in the Tonto has suffered long-term damage from the Rodeo-Chediski and other fires. Over the past twenty years, nearly 30% of the saguaro cacti in the TNF were destroyed by large fires. Research shows that heightened mortality in these cacti from fires continues for a decade or longer, the exposed population suffering a 400% greater mortality than unaffected cacti (Narog and Wilson 2003).

It is important to note, however, 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.).

In general, 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 treatments¹, controlled fire treatments (used here to include both prescribed and natural-ignition “wildland fire use” fires), and direct suppression of fires.

The White House 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. It also calls for aggressive thinning projects 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 (Office of the President 2002). Some researchers echo this claim, blaming no-cut environmentalists for creating an environment 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 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 (Eilperin 2004). Litigation has undeniably delayed, prevented, or changed some fuel-reduction projects. However, several studies have shown that the impact and scope of litigation on national forest logging plans has been substantially overstated (Cortner et al. 2003, Carter 2003).

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 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 developments meet often highly flammable wildlands, fire on public lands can be a major concern for neighbors on private lands.

¹ 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.

Nationally, the focus of fire policy 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. 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 widely acknowledged concept that ecosystem health has declined since the arrival of Europeans on the North American continent is linked in large part with a reduction in the biodiversity and 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.

Throughout the world, invasive species seriously affect forest ecosystems to the detriment of biological diversity, forest health, forest productivity, soil and water quality, and socioeconomic values (Chornesky et al. 2005). In the United States, researchers estimate that the roughly 360 non-native insect species that have invaded forests cost about \$2.1 billion per year in the loss of forest products alone. A similar value is also 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. A 2002 bark beetle infestation affecting many Arizona and New Mexico forests 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).

The 2002 bark beetle infestation produced serious effects within the Tonto National Forest. Beetle activity was recorded on over 161,180 acres of Tonto pine forest land, and piñon mortality in the forest from the beetles covered 23,895 acres (USFS 2004d). Infestations of non-endemic weeds have also become an increasing concern in the area containing Prescott, Tonto, and Coconino National Forests. According to the USFS (2005d), 187,500 acres in the three forests 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 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.

Invasive grass species have also impacted both desert and grassland ecosystems in Arizona. In western deserts, 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 of 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. Forage losses due to invasive weed species have been estimated at nearly \$1 billion per year (Pimentel, Zuniga, and Morrison 2005).

As invasive species threaten a wide variety of forest resources and uses, including both recreational 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, available at <http://www.invasives.org>, provides detailed information on a wide variety of invasive weeds, diseases, insects, and other species. 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 southern 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).

Unmanaged Recreation

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 was limited, with only 600,000 visitor days in the state of Arizona. Twenty years ago, however, visitor days had increased to nearly 15 million, making the national forests the main recreational resource in the Southwest (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 Tonto alone, there are between 5.1-6.3 million visits each year to the national forest itself and between 84,000-134,000 wilderness visits, making the TNF one of the more visited forests in the state and establishing tourism as one of the single most vital economic factors to the communities surrounding the forest (Kocis et al. 2003b).

In Arizona, access to recreational activities on federal- and state-protected land is important and valuable to the general public. 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). 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 their inherent risk has caused officials to consider special use fees to cover added ranger responsibilities surrounding climbing-related injuries (Cordell et al. 1999).

The explosive growth of recreational use presents challenges to managers even as the public receives increasing benefits from its forests and grasslands. At the national level, the Forest Service 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 the foremost reasons for forest usage (Peart 1995, Knopf 1987).

Given the rapid growth of Arizona's population, overcrowding may eventually be an increasing challenge for the TNF although, at present, it does not seem to be an issue. According to NVUM data, more than 52% of visitors interviewed stated that there appeared to be hardly anyone else present during wilderness visits and only 18% of those interviewed considered overcrowding on developed overnight sites to be a problem in the Tonto, one of the best proportions for Arizona's national forests (Kocis et al. 2003b).

A related issue that has drawn some national 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 America's national parks. 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 97% of the wilderness visitors to the TNF 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. 2003b).

9.2 Land and water resources

Arizona is among the fastest growing states. The United States' aging population—one in eight people in the U.S. is now over 65 as opposed to one in twenty-five 100 years ago—is leading to more and more people escaping to the warmer climates of the South and West (Alig et. al. 2003). 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). 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. We have described how, as a result, 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 18th 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 by no means linear. 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).

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. Grazing fees have become controversial in part because the fee has increased only marginally from its inception and has not kept pace with the market rates. In 2002, for example, the grazing fee remained \$1.35 per AUM² 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

Evidence suggests that Tonto National Forest has experienced considerable environmental alteration from historical grazing habits. In 1926, Fred Coxen, then a senior forest manager, related the story of Reverend Fuller, who came to the Tonto Basin in the late 1870s. The reverend described a land filled with "Red Topped grass" that he claimed "grew to a height of about sixteen inches." As Coxen noted in his speech, "There is none of this grass to be found now" (Coxen 1926). Investigating historical grassland ecosystems, researchers have studied the area surrounding Dutchwoman Butte, an area of land which, due to its relatively rough terrain and lack of accessibility, is considered to be in much the same state as it would have been before the arrival of Europeans. Examination done on the plains has shown that the fauna and grasses present in this area are strikingly different from other areas in Tonto with similar soil composition. In contrast to nearby, grazed areas, which are dominated by a 16% canopy of curly mesquite and whose only grass is *sideoats grama*, Dutchwoman Butte has twelve species, and a 40% canopy, of grasses (Ambos, Robertson, and Douglas 2000).

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, introductions of exotic weeds, and the construction of fences and roads, can bring it into conflict with other uses (Freilich et al. 2003). For example, soil compaction from grazing herds can affect the water table and rainfall infiltration as well as

² An AUM, or Animal Unit Month, is equal to one cow with calf or five sheep feeding for one month.

erode streambanks. Watersheds that have been subjected to prolonged overgrazing are more susceptible to flooding and accelerated channel lowering (Belsky, Matzke, and Uselman 1999; Dreeson et al. 2002; USFS 2002a). In the Tonto in particular, excessive grazing has been identified as a major cause of increased fire frequency (Huggard 2001, Carter 2003). A suitable balance and relationship between livestock grazers, environmentalists, and the Forest Service is important and, 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

In Arizona, the practice of allocating public lands for various beneficiaries 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 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 (Brown 1999, 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).

Watershed integrity is of specific importance for Tonto National Forest inasmuch as the area was made a federal protectorate in order to preserve its watersheds. There are numerous dams and man-made lakes

across the forest and the annual rainfall exceeds sixteen inches. Although the forest ranks second in water production overall, it is by far the most important forest in terms of water storage. Its numerous dams—including the Roosevelt, Saguaro, Apache, Canyon, and Horseshoe—provide essential facilities for water reclamation as well as provide preventative protection against floods. With much of this water providing the residents of Phoenix, the state's largest city, the health and welfare of Tonto's watersheds remains an important priority for the forest and the surrounding communities (Baker et. al. 1998).

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). Recently, the Secretary of the Interior noted that, barring changes, action would be necessary at the federal level within two or three years. Low rainfall has led to periodic drops in water levels in nearly all primary reservoirs in Arizona. 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. Two of the watersheds closest to the Tonto, the Verde and Salt River Systems, were up to 90% and 95% of capacity respectively at the time of this assessment. 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; CLIMAS, June 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). 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, deliveries at the end of the last decade were up to about 10 maf, well above the requirements of the compact (Brown 1999).

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).

Active management of the water resources on public and private lands is a complex and multifaceted endeavor. Considering the value of water resources on forest service lands, 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 Tonto 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 than 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 untrammelled 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 TNF includes approximately 170,000 acres of inventoried roadless areas (USFS 2001c).

In 2001, the FS published a final rule that prohibited several activities in inventoried roadless areas (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 5th, 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 surrounding communities. According to Silberman (2003), OHV users spent a combined \$1.8 billion³ in 2002 in Maricopa, Pinal, Yavapai, and Gila Counties, representing \$97.8 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 TNF 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

³ 75% of this amount comes as a result of Maricopa County

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 TNF 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 Tonto National Forest 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. Without question, the dramatic growth of the Phoenix Metropolitan Area has had a tremendous impact not only on this forest, but on the state of Arizona as a whole. According to the 2000 Census, the Phoenix–Mesa Metropolitan Area was the fourteenth largest, and the eighth fastest growing metro area in the United States. Over the last fifty years, the amount of land, water, and infrastructure devoted to supporting this growth has had a tremendous impact on the economic development of Maricopa County and the state as a whole. Over the next fifty years, as previously rural areas of Arizona become increasingly urban, the demand for natural and physical resources needed to sustain population growth and economic development will surely influence the future management alternatives of the TNF.

Data also show that overall population within the four counties surrounding the TNF increased by over one hundred percent between 1980 and 2000. 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 total housing, housing density and homes intended for seasonal use. 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 TNF and surrounding communities.

The economy of central Arizona is also likely to have a substantial impact on future planning and management on the TNF. Data suggest that economic growth in the region has been relatively strong when compared to state averages over the past several years. This is highlighted in part by considerable increases in total full- and part-time employment as well as per capita and household income. Meanwhile, recent indicators of dependence on natural resources have shown mixed results. Between 1990 and 2000, gains in income from tourism and wood products were offset by losses in income from special forest products. Although activities such as mining and ranching 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 TNF'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 TNF. 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 TNF 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 the national forests. This trend is supported by national surveys showing continued declines in timber harvesting and recent data on the Tonto National Forest which demonstrate similar declines in extractive use of forest lands. These same reports point toward a substantial increase in recreational uses of national forests in general and the TNF 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 TNF 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 TNF has designated dozens of wilderness areas, trailheads, camping and picnic areas, along with other cultural and recreation sites within forest boundaries. Forest archeologists and recreation staff have also made considerable progress in identifying a number of areas throughout central Arizona that are considered special by Native American tribes, descendants of early settlers, and wilderness enthusiasts. In the future, the TNF should continue to seek input from these and other groups in identifying special places and planning for their protection.

Regional trends and Forest Service planning regulations have influenced the relationships between the TNF and surrounding communities. In particular, the protection of wildlife, prevention of forest fire, and the sustainable management of area watersheds 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 TNF management objectives.

Finally, data suggest that a number of natural resource issues will continue to influence future management alternatives of the Tonto 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.

11. Works Cited

- Adams-Russell Consulting. 2004. Social assessment: Clearwater National Forest and Nez Perce National Forest. Placerville, CA. 218p.
- Alford, E. 2005. Personal Communication. Forest Planner. Tonto National Forest.
- Alig, R.J., and B.J. Butler. 2004. Area changes for forest cover types in the United States, 1952 to 1997, with projections to 2050. Gen. Tech. Rep. PNW-GTR-613. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 106p.
<http://www.treesearch.fs.fed.us/pubs/viewpub.jsp?index=7303>
- Alig, R.J., A.J. Plantinga, S. Ahn, and J.D. Kline. 2003. Land use changes involving forestry in the United States: 1952 to 1997, with projections to 2050. Gen. Tech. Rep. PNW-GTR-587. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 92p.
<http://216.48.37.142/pubs/viewpub.jsp?index=5596>
- Allen, L.S. 1989. Roots of the Arizona livestock industry. *Rangelands*. 11:9-13.
- Ambos, N., G. Robertson, and J. Douglas. 2000. Dutchwoman Butte: A relict grassland in central Arizona. *Rangelands*. 22:3-8. <http://uvalde.tamu.edu/rangel/apr00/ambos.pdf>
- Arizona Department of Commerce (ADOC). 2002a. Arizona's economic future. Prepared by Economy.com. 92p. <http://www.maricopa.edu/workforce/pdfs/AZEconFuture.pdf>
- Arizona Department of Transportation (ADOT). 2004a. MoveAZ long range transportation plan. Appendix B: Issues Papers. Prepared by Cambridge Systematics, Inc.
http://www.moveaz.org/Documents/MoveAZ_AppB.pdf
- Arizona Department of Transportation (ADOT). 2004b. MoveAZ long range transportation plan. Synthesis of Issues Papers. <http://www.moveaz.org/Documents/issuepapersynth.pdf>
- Arizona Department of Transportation (ADOT). 2004c. MoveAZ long range transportation plan.
http://www.moveaz.org/Documents/MoveAZ_Chap1-9.pdf
- Arizona Office of Tourism (AZOT). 2004a. Arizona Tourism Statistical Report, 2003. 47p.
<http://www.azot.com/research/data/2003%20Statistical%20Report.pdf>
- Arizona Office of Tourism (AZOT). 2004b. AZ Regional Profiles.
<http://www.azot.gov/research/researchdocs.asp?catid=48>
- Arizona State Land Department (AZSLD). 2004. Arizona State Land Department annual report: 2003-2004. http://www.land.state.az.us/report/report_full.pdf
- Arizona State Land Department (AZSLD). 2005. <http://www.land.state.az.us/index.html>
- Arizona State Parks. 2003. Arizona Statewide Comprehensive Outdoor Recreation Plan. Partnerships Division, Arizona State Parks and Land and Water Conservation Fund. 114p.
<http://www.pr.state.az.us/partnerships/planning/scorp03.html>.

- Arizona State Parks. 2004. Arizona trails 2005: State motorized and non-motorized trail plan. 110p.
<http://www.pr.state.az.us/partnerships/trails/statetrails.html>
- Arizona Town Hall. 1999. Uniting a diverse Arizona. Report on the Seventy-Fifth Arizona Town Hall.
www.aztownhall.org/75report.doc
- Baden, J.A. and D. Snow (eds.). 1997. *The Next West: Public Lands, Community and Economy in the American West*. Gallatin Institute. Island Press, Washington DC. 272p.
- Baldwin, P. 2004. The National Forest System Roadless Areas Initiative. Rep. RL30647. Congressional Research Service, Library of Congress. 27p.
<http://www.ncseonline.org/NLE/CRS/abstract.cfm?NLEid=16808>
- Baker, R.D., R.S. Maxwell, V.H. Treat, and H.C. Dethloff. 1988. *Timeless Heritage: A History of the Forest Service in the Southwest*. FS-409. USDA Forest Service. College Station, TX: Intaglio, Inc. 208p.
<http://www.fs.fed.us/r3/about/history/timeless/index.shtml>
- Beaver, M. 2003. Dropping lake levels expose historic ruins. *Arizona Daily Star*. 10 Mar.
<http://www.ibsgwatch.imagedjinn.com/learn/2003/2003march.htm>
- Becerra, H., and D. Pierson. 2005. April showers may bring scorcher. *Los Angeles Times*. 21 May.
- Belsky, J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. *Journal of Soil and Water Conservation*. 54:419-431.
<http://www.onda.org/library/papers/BelskyGrazing.pdf>
- Bluewater Network. 1999. *Off-the-Track: America's national parks under siege*. 41p.
http://bluewaternetwork.org/reports/rep_pl_offroad_offtrack.pdf
- Bodemann, Y.M. 1988. Relations of production and class rule: The hidden basis of patron-clientage, pp. 198-220. *In: B. Wellman and S.D. Berkowitz (eds.), Social Structures: A Network Approach*. Cambridge University Press, Cambridge. 508p.
- Bodio, S. 1997. Struck with consequence, pp. 15-24. *In: J.A. Baden and D. Snow (eds.), The Next West: Public Lands, Community and Economy in the American West*. Gallatin Institute. Island Press, Washington D.C. 272p.
- Booth, D.E. 2002. *Searching for Paradise: Economic Development and Environmental Change in the Mountain West*. Rowman and Littlefield Publishers, Inc., Lanham, Maryland. 288p.
- Brandenburg, A.M., and M.S. Carroll. 1995. Your place or mine?: The effect of place creation on environmental values and landscape meanings. *Society and Natural Resources*. 8:381-398.
- Brandenburg, A.M., M.S. Carroll, and K.A. Blatner. 1995. Towards successful forest planning through locally based qualitative sociology. *Western Journal of Applied Forestry*. 10(3):95-100.
- Brandes, U., P. Kenis, J. Raab, V. Schneider, and D. Wagner. 1999. Explorations into the visualization of policy networks. *Journal of Theoretical Politics*. 11(1):75-106.
<http://jtp.sagepub.com/cgi/reprint/11/1/75>

- Breiger, R.L. 1988. The duality of persons and groups, pp. 83-98. *In*: B. Wellman and S.D. Berkowitz (eds.), *Social Structures: A Network Approach*. Cambridge University Press, Cambridge. 508p.
- Brown, T.C. 1999. Past and future freshwater use in the United States: A technical document supporting the 2000 USDA Forest Service RPA Assessment. Gen. Tech. Rep. RMRS-GTR-39. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 47p.
http://www.fs.fed.us/rm/pubs/rmrs_gtr039.html
- Bullard, R.D. 1993. Race and environmental justice in the United States. *Yale Journal of International Law*. 18:319-336.
- Bureau of Economic Analysis (BEA). 2002. Local area personal income. U.S. Dept. of Commerce.
<http://www.bea.gov/bea/regional/reis/>
- Canamex Corridor Coalition. 2001. Task I: Existing infrastructure—Economic conditions and programs/ transportation infrastructure/ telecommunications infrastructure. ADOT Contr. No. AD000088001. Prepared by Economics Research Associates. 82p.
- Carter, R. 2003. Climate, forest management, stoke western wildfires. End in sight. CLIMAS. 4p.
http://www.ispe.arizona.edu/climas/forecasts/articles/wildfire_April2003.pdf
- Case, P., and G. Alward. 1997. Patterns of demographic, economic and value change in the western United States: Implications for water use and management. Report to the Western Water Policy Review Advisory Commission. U.S. Dept. of Agriculture, Forest Service. 70p.
http://www.fs.fed.us/institute/news_info/wwprc_1.html
- Cheng, A.S., L.E. Kruger, and S.E. Daniels. 2003. "Place" as an integrating concept in natural resource politics: Propositions for a social science research agenda. *Society and Natural Resources*. 16:87-104.
- Chornesky, E.A., A.M. Bartuska, G.H. Aplet, K.O. Britton, J. Cummings-Carlson, F.W. Davis, J. Eskow, D.R. Gordon, K.W. Gottschalk, R.A. Haack, A.J. Hansen, R.N. Mack, F.J. Rahel, M. Shannon, L.A. Wainger, and T.B. Wigley. 2005. Science priorities for reducing the threat of invasive species to sustainable forestry. *BioScience*. 55(4):335-348.
<http://docserver.ingentaconnect.com/deliver/cw/aibs/00063568/v55n4/s10/p335.pdf?fmt=dirpdf&tt=479&cl=22&ini=connect&bini=&wis=connect&ac=0&acs=4703,291891,57006404,30000342&kn=1&expires=1117753790&checksum=0065CC4DCC2E1A61161D75295214D652&cookie=1329481216>
- Clawson, M. 1985. Trends in the use of public recreation areas, pp. 1-12. *In*: Proceedings, 1985 National Outdoor Recreation Trends Symposium II; 24-27 Feb. Myrtle Beach: Clemson, SC: Department of Parks, Recreation and Tourism Management.
- Climate Assessment for the Southwest (CLIMAS). 2004-2005. Monthly Southwest Climate Outlook.
<http://www.ispe.arizona.edu/climas/forecasts/archive.html>
- Clinton, W.J. 1994. Federal action to address environmental justice in minority populations and low-income populations. Executive Order 12898. White House, Washington, DC. 11 Feb.
www.fs.fed.us/land/envjust.html
- Coalition for Sonoran Desert Protection. 2001. Livestock grazing and the Sonoran Desert Conservation Plan. 45p. <http://www.biologicaldiversity.org/swcbd/programs/grazing/SDCP-Report.pdf>

- Cody, B.A. 2001. Grazing fees: An overview. CRS Congressional Report, 96-450 ENR. National Council for Science and the Environment. <http://www.ncseonline.org/NLE/CRSreports/Agriculture/ag-5.cfm>
- Colorado River Water Users Association (CRWUA). Overview. 2005. CRWUA Website. http://www.crwua.org/colorado_river/overview.htm
- Cordell, H.K., C.J. Betz, G.T. Green, S. Mou, V.R. Leeworthy, P.C. Wiley, J.J. Barry, and D. Hellerstein. 2004. Outdoor Recreation for 21st Century America. State College, PA: Venture Publishing, Inc. 316p.
- Cordell, H.K., B.L., McDonald, R.J. Teasley, J.C. Bergstrom, J. Martin, J. Bason, and V.R. Leeworthy. 1999. Outdoor recreation participation trends, pp. 219-321. *In*: H.K. Cordell et al., *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*. Sagamore Publishing, Champaign, IL. 449p. <http://www.srs.fs.usda.gov/pubs/viewpub.jsp?index=767>
- Cordell, H.K., J. Teasley, and G. Super. 1997. Outdoor recreation in the United States: Results from the National Survey on Recreation and the Environment (All Forest Service Regions). Prepared by the Outdoor Recreation and Wilderness Assessment Group. Dept. of Agriculture and Applied Economics, University of Georgia. 209p. <http://www.srs.fs.usda.gov/trends/fsoutrec.html>
- Coronado National Forest (CNF). 2003b. Coronado National Forest Fire Management Plan. U.S. Dept. of Agriculture, Forest Service. 164p. http://www.fs.fed.us/r3/coronado/forest/projects/fire_mgt/wfa/documents/fmp/fmp.pdf
- Cortner, H.J., M. Gretchen, R. Teich, and J. Vaughn. 2003. Analyzing USDA Forest Service appeals: Phase 1, the database. Ecological Restoration Institute. Northern Arizona University. 58p. <http://www.nativeforest.org/pdf/FS-appeals-database.pdf>
- Croxen, F.W. 1926. History of Grazing on Tonto. Presented at the Tonto Grazing Conference, Phoenix, AZ, 4-5 Nov. <http://www.rangebiome.org/genesis/GrazingOnTonto-1926.html>
- D'Antonio, C.A., and P.J. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. *Annual Review of Ecology and Systematics*. 23:63-87. [arjournals.annualreviews.org/doi/pdf/10.1146/annurev.es.23.110192.000431](http://journals.annualreviews.org/doi/pdf/10.1146/annurev.es.23.110192.000431)
- Davis, C. 2001. Introduction: The context of public lands policy change, pp. 1-8. *In*: C. Davis (ed.), *Western Public Lands and Environmental Politics* (2nd Ed.). Westview Press, Boulder, CO. 240p.
- Davis, T. 2004. Leader of group seeking state land changes resigns. *Arizona Daily Star*. 2 Oct.
- Domenici, P. 2003. Report outlining approval of H.R. 622 for implementation of land exchange on the Tonto National Forest. Senate Report, 108th Congress, Calendar No. 261. 29 Jul. <http://thomas.loc.gov/cgi-bin/cpquery/T?&report=sr137&dbname=cp108&>
- Dreesen, D., J. Harrington, T. Subirge, P. Stewart, and G. Fenchel. 2002. Riparian restoration in the southwest—species selection, propagation, planting methods, and case studies. Gen. Tech. Rep. RMRS-P-24. U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 370p. <http://plantmaterials.nrcs.usda.gov/pubs/nmpmcsy03852.pdf>

- Duffus, J. 1992. Federal lands – Reasons for and effects of inadequate public access. Briefing Report to the Chairman, Subcommittee on National Parks and Public Lands, Committee on Interior and Insular Affairs, House of Representatives. U.S. General Accounting Office.
<http://archive.gao.gov/d32t10/146394.pdf>
- Ecological Restoration Institute. 2005. Strategic plan. Northern Arizona University. 13p.
<http://www.eri.nau.edu/forms/files/strategicplan2003.pdf>
- Eilperin, J. 2004. National forests fall victim to firefighting: Plan to protect residences costs trees, money. Washington Post. 29 Jun., A03.
<http://www.washingtonpost.com/wp-dyn/articles/A13324-2004Jun28.html>
- Elsner, G., and R. C. Sardon (tech. coords.). 1979. Our national landscape: A conference on applied techniques for analysis and management of the visual resource. Gen. Tech. Rep. PSW-35. Berkeley, CA: U.S. Dept. of Agriculture, Forest service, Pacific Southwest Forest and Range Experiment Station. 752p.
- Esparza, A.X., and J.I. Carruthers. 2000. Land use planning and exurbanization in the rural Mountain West: Evidence from Arizona. *Journal of Planning Education and Research* 20:23-36.
<http://jpe.sagepub.com/cgi/reprint/20/1/23>
- Fedkiw, J. 1998. Managing multiple uses on national forests, 1905-1995: A 90-year learning experience and it isn't finished yet. FS-628. USDA Forest Service, Washington, DC. 284p.
http://www.fs.fed.us/research/publications/Managing_Multiple_Uses.htm
- Flather, C.H., S.J. Brady, and M.S. Knowles. 1999. Wildlife resource trends in the United States: A technical document supporting the 2000 RPA Assessment. Gen. Tech. Rep. RMRS-GTR-33. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 79p.
http://www.fs.fed.us/rm/pubs/rmrs_gtr33.html
- Forstall, R.L. 1995. Arizona: Population of counties by decennial census—1900 to 1990. U.S. Bureau of the Census, Population Division. <http://www.census.gov/population/cencounts/az190090.txt>
- Freilich, J.E., J.M. Emlen, J.J. Duda, D.C. Freeman, and P.J. Cafaro. 2003. Ecological effects of ranching: A six-point critique. *BioScience*. 53(8): 759-765.
<http://www.alamedacreek.org/Educational%20Resources/Livestock%20grazing%20resources/Ecological%20Effects%20of%20Ranching%20--%20A%206%20point%20critique.pdf>
- Frentz, I. C., S. Burns, D.E. Voth, and C. Sperry. 1999. Rural development and community-based forest planning and management: A new, collaborative paradigm (Executive Summary). Fayetteville, Arkansas: University of Arkansas. <http://ocs.fortlewis.edu/Stewardship/Pubns/execsummary.pdf>
- Galaskiewicz, J., and S. Wasserman. 1994. Introduction: Advances in the social and behavioral sciences from social network analysis, pp. xi-xvii. *In*: S. Wasserman and J. Galaskiewicz (eds.), *Advances in Social Network Analysis*. Sage Publications, Thousand Oaks. 300p.
- Garson, G.D. 2005. Sociometry and Network Analysis, online notes. *In*: G.D. Garson, PA 765 Statnotes: An Online Textbook. North Carolina State University, Raleigh, NC.
<http://www2.chass.ncsu.edu/garson/pa765/sociometry>.
- General Accounting Office (GAO). 1987. National forests: Timber utilization policy needs to be reexamined.

- GAO/RCED 88-31. Report to the Chief, Forest Service, U.S. Dept. of Agriculture. 10p. <http://archive.gao.gov/d29t5/134436.pdf>
- General Accounting Office (GAO). 1988. Rangeland management: More emphasis needed on declining and overstocked grazing allotments. GAO/RCED 88-80. Report to Congressional Requesters. 71p. <http://archive.gao.gov/t2pbat17/136027.pdf>
- General Accounting Office (GAO). 1989. Federal land management: The Mining Law of 1872 needs revision. GAO/RCED 89-72. Report to the Chairman, Subcommittee on Mining and Natural Resources, Committee on Interior and Insular Affairs, House of Representatives. 47p. <http://archive.gao.gov/d15t6/138159.pdf>
- General Accounting Office (GAO). 1991. Forest Service: Difficult choices face the future of the recreation program. GAO/RCED 91-115. Report to the Chairman, Subcommittee on National Parks and Public Lands, Committee on Interior and Insular Affairs, House of Representatives. 28p. <http://archive.gao.gov/t2pbat8/143648.pdf>
- General Accounting Office (GAO). 1995. Federal lands: Information on the use and impact of off highway vehicles. GAO/RCED 95-209. Report to Bruce F. Vento, House of Representatives. 77p. <http://www.gao.gov/archive/1995/rc95209.pdf>
- General Accounting Office (GAO). 1996. U.S. Forest Service: Fees for recreation special-use permits do not reflect fair market value. GAO/RCED 97-16. Report to the Chairman, Subcommittee on Oversight of Government Management and the District of Columbia, Committee on Governmental Affairs, U.S. Senate. 27p. <http://www.gao.gov/archive/1997/rc97016.pdf>
- General Accounting Office (GAO). 1998. Recreation fees: Demonstration fee successful in raising revenues but could be improved. GAO/RCED 99-7. Report to Congressional Requesters. 116p. <http://www.gao.gov/archive/1999/rc99007.pdf>
- General Accounting Office (GAO). 1999a. Forest Service priorities: Evolving mission favors resource protection over production. GAO/RCED 99-166. Report to Chairman, Subcommittee on Forests and Public Land Management, Committee on Energy and Natural Resources, U.S. Senate. 16p. <http://www.gao.gov/archive/1999/rc99166.pdf>
- General Accounting Office (GAO). 1999b. Forest Service: Amount of timber offered, sold, and harvested, and timber sales outlays, fiscal years 1992 through 1997. GAO/RCED 99-174. Report to Chairman, Subcommittee on Department Operations, Oversight, Nutrition, and Forestry, Committee on Agriculture, House of Representatives. 78p. <http://www.gao.gov/archive/1999/rc99174.pdf>
- General Accounting Office (GAO). 2001a. Financial management: Annual costs of Forest Service's timber sales program are not determinable. GAO 01-1101R. Memo to Cynthia McKinney and George Miller, House of Representatives. 7p. <http://www.gao.gov/new.items/d011101r.pdf>
- General Accounting Office (GAO). 2001b. Recreation fees: Management improvements can help the demonstration program enhance visitor services. GAO 02-10. Report to the Ranking Minority Member, Subcommittee on National Parks, Historic Preservation, and Recreation, Committee on Energy and Natural Resources, U.S. Senate. 37p. <http://www.gao.gov/new.items/d0210.pdf>
- Gila County. 2003. Gila County Comprehensive Master Plan. LVA Urban Design Studio, L.L.C.;

- Kimley Horn and Associates, Inc. <http://www.co.gila.az.us/default.aspx>
- Gorte, R.W. 2004. Below-cost timber sales: An overview. CRS Report RL32485. Congressional Research Service, Library of Congress. 11p. <http://www.ncseonline.org/NLE/CRSreports/04Jul/RL32485.pdf>
- Graham, R.T., S. McCaffrey, and T.B. Jain (tech. eds.). 2004. Science basis for changing forest structure to modify wildfire behavior and severity. Gen. Tech. Rep. RMRS-GTR-120. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 43p. http://www.fs.fed.us/rm/pubs/rmrs_gtr120.html
- Grewell, B.J. 2004. Recreation fees: Four philosophical questions. PERC Policy Series. PS-31. 32p. http://www.perc.org/publications/policyseries/rec_fees.php?s=2
- Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes (eds.). 2001. Forest roads: A synthesis of scientific information. Gen. Tech. Rep. PNW-GTR-509. U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 103p. <http://www.fs.fed.us/pnw/pubs/gtr509.pdf>
- Hanneman, R.A. 1999. Introduction to Social Network Methods (online text). Analytic Technologies. 149p. <http://www.analytictech.com/networks.pdf>
- Haynes, R.W. (tech. coord.). 2003a. An analysis of the timber situation in the United States: 1952 to 2050. Gen. Tech. Rep. PNW-GTR-560. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 254p. <http://www.treearch.fs.fed.us/pubs/viewpub.jsp?index=5284>
- Hobbs, F., and N. Stoops. 2002. Demographic trends in the 20th Century. U.S. Census Bureau. Census 2000 Special Reports, Series CENSR-4. U.S. Government Printing Office, Washington, DC. 228p. <http://www.census.gov/prod/2002pubs/censr-4.pdf>
- Huggard, C.J. 2001. Introduction. *In* C.J. Huggard, and A.R. Gomez (Eds.), *Forests Under Fire: A Century of Ecosystem Mismanagement in the Southwest*. Tucson: University of Arizona Press. 307p. <http://www.uapress.arizona.edu/samples/sam1375.htm>
- Humphries, M., and C.H. Vincent. 2004. Mining on federal lands. CRS Issue Brief for Congress. IB89130. National Library for the Environment, Resources, Science, and Industry Division. http://www.ncseonline.org/NLE/CRSreports/Mining/mine1.cfm?&CFID=8492224&CFTOKEN=29386060#_1_1
- Jevons, D. 2005. Personal Communication. Acting Forest Planner. Apache-Sitgreaves National Forests.
- Johnson, H. 2005. \$1.5 mil house destroyed in blaze; cause is sought. *The Arizona Republic*. 6 May. <http://www.azcentral.com/arizonarepublic/local/articles/0506nfire06.html>
- Johnson, T.G. (Ed.). 2000. United States timber industry—An assessment of timber product output and use, 1996. Gen Tech. Rep. SRS-45. Asheville, NC: U.S. Dept. of Agriculture, Forest Service, Southern Research Station. 145p. <http://www.srs.fs.usda.gov/pubs/viewpub.jsp?index=2829>
- Knopf, R. 1987. Human behavior, cognition, and affect in the natural environment, pp. 783-827. *In*: D. Stokols and I. Altman (eds.), *Handbook of Environmental Psychology*. John Wiley and Sons, New York. 1684p.
- Kocis, S.M., D.B.K. English, S.J. Zarnoch, R. Arnold, and L. Warren. 2003b. National Visitor Use

- Monitoring Results. USDA Forest Service Region 3. Tonto National Forest.
http://www.fs.fed.us/recreation/programs/nvum/reports/year3/R3_F12_tonto_final.doc
- Kruger, L.E. 1996. Understanding Place as a Cultural System: Implications of Theory and Method. Ph.D. Dissertation. University of Washington, Seattle, WA. 180 p.
- Kyl, J. 2005. Southeast Arizona Land Exchange and Conservation Act of 2005. S. 1122. 109th Congress, 1st Session. 25 May. <http://thomas.loc.gov/cgi-bin/query/F?c109:1:./temp/~c109Yfaaz0:e318>
- Leefers, L., K. Potter-Witter, and M. McDonough. 2003. Social and economic assessment of the Michigan National Forests. Department of Forestry, Michigan State University. 254p.
- Madrid, B. 2004. Personal communication. Fire Management Office, Gila National Forest Wilderness District, USDA Forest Service. 17 Sep.
- Maricopa Association of Governments (MAG). 2003. Maricopa Association of Governments Regional Transportation Plan. Maricopa Association of Governments. 195p.
<http://www.mag.maricopa.gov/pdf/cms.resource/RTP-Final-11-25-03.pdf>
- Maricopa County. 2001. Growth areas: 2020 Eye to the future. Planning and Development Department Maricopa County, AZ. 21p.
- Maricopa County. 2002. Maricopa County Comprehensive Plan: 2020 Eye to the Future.
<http://www.maricopa.gov/planning/compln/plan/plan.pdf>
- McCool, S.F. 2003. From scholarship to stewardship: Opportunities and challenges in wilderness research, education, and management. U.S. Dept. of Agriculture, Forest Service Proceedings. RMRS-P-27:218-224. http://www.fs.fed.us/rm/pubs/rmrs_p027/rmrs_p027_218_224.pdf
- McCool, S.F. 2001. Quaking aspen and the human experience: Dimensions, issues, and challenges, pp. 147-160. *In*: Sustaining aspen in western landscapes: Symposium Proceedings. RMRS-P-18. Grand Junction, CO: U.S. Dept. of Agriculture, Rocky Mountain Research Station, Forest Service Proceedings. 13-15 Jun. http://www.fs.fed.us/rm/pubs/rmrs_p018/rmrs_p018_147_162.pdf
- McCool, S.F., and L.E. Kruger. 2003. Human migration and natural resources: Implications for land managers and challenges for researchers. Gen. Tech. Rep. PNW-GTR-580. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 19p.
<http://www.fs.fed.us/pnw/pubs/gtr580.pdf>
- McHugh, K.E., and R.C. Mings. 1996. The circle of migration: Attachment to place in aging. *Annals of the Association of American Geographers*. 86(3):530-550.
<http://www.jstor.org/view/00045608/di010520/01p0038p/0?currentResult=00045608%2bdi010520%2b01p0038p%2b2%2cC8060C&searchUrl=http%3A%2F%2Fwww.jstor.org%2Fsearch%2FResults%3FQuery%3DCoronado%2BNational%2BForest%2Bborder%2Bissues%26hp%3D25%26so%3Dnull%26si%3D1%26mo%3Dbs>
- McMillan, W. 1999. The community relations manual: A guide for local government. Department of the Premier and Cabinet. Office of Ethnic and Multicultural Affairs. Queensland, Australia. 90p.
http://www.premiers.qld.gov.au/library/office/Community_Relations_Manual.doc
- Meahl, J. 2005. More wildfires likely as restrictions in effect. *Eloy News*. 19 May.

http://www.zwire.com/site/news.cfm?newsid=14555409&BRD=1817&PAG=461&dept_id=222071&rfti=8

- Merrill, B.D. 1998. Arizona's support balance: Attitudes toward rural communities and environmental values. Arizona State University, Walter Cronkite School. Prepared for the Eastern Arizona Counties Organization. 24p.
- Mills, J.R., and X. Zhou. 2003. Projecting national forest inventories for the 2000 RPA timber assessment. Gen. Tech. Rep. PNW-GTR-568. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 58p. <http://www.fs.fed.us/pnw/pubs/gtr568.pdf>
- Mitchell, J.E. 2000. Rangeland resource trends in the United States: A technical document supporting the 2000 USDA Forest Service RPA Assessment. Gen. Tech. Rep. RMRS-GTR-68. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 84p. http://www.fs.fed.us/rm/pubs/rmrs_gtr68.html
- Mitchell, M.Y., J.E. Force, M.S. Carroll, and W.J. McLaughlin. 1993. Forest places of the heart: Incorporating special places into public management. *Journal of Forestry*. 91(4):32-37.
- Morehouse, B.J. 2001. Climate, forest fires, and recreation: Insights from the U.S. Southwest. University of Arizona, Institute for the Study of Planet Earth, pp. 195-226. *In*: A. Matzarakis and C.R. de Freitas (eds.), *Proceedings of the First International Workshop on Climate, Tourism, and Recreation*. International Society of Biometeorology. Report of a Workshop Held at Porto Carras, Neos Marmaras, Halkidiki, Greece, 5-10 Oct. 2001. 265p.
- Morton, P. 2003. Economic profiles for Arizona counties: Coconino County. Wilderness Society. 9p. <http://www.wilderness.org/Library/Documents/upload/Coconino-County-Economic-Profile-AZ.pdf>
- Napolitano, J. 2004. Arizona water management: Keeping the glass full. Speech given at Arizona Town Hall. 1 Nov. http://www.governor.state.az.us/press/0411/04_11_04.pdf
- Narog, M.G. and R.C. Wilson. 2003. Delayed mortality: Saguaro cacti are still dying 10 years after wildfire. Paper presented at the 5th Symposium on Fire and Forest Meteorology and the 2nd International Wildland Fire Ecology and Fire Management Congress (P 2.9), Orlando, FL, 17 Nov. 6p. <http://ams.confex.com/ams/pdfpapers/66142.pdf>
- National Agricultural Statistics Service (NASS). 2003. United States Dept. of Agriculture. Economics and Statistics System. Albert R. Mann Library, Cornell University. <http://jan.mannlib.cornell.edu/reports/nassr/price/pap-bb/2003/agpr0103.txt>
- National Forest Foundation (NFF), and United States Forest Service (USFS). 2005. Partnership Guide: The Power of People Working Together. National Partnership Office. 104p. <http://www.partnershipresourcecenter.org/resources/partnership-guide/>
- National Interagency Fire Center (NIFC). 2003. Interagency strategy for the implementation of federal wildland fire policy. U.S. Dept. of Agriculture, U.S. Dept. of the Interior. National Fire and Aviation Executive Board. Federal Fire Policy Directives Task Group. 62p. http://www.nifc.gov/fire_policy/pdf/strategy.pdf
- National Interagency Fire Center (NIFC). 2005. Wildland Fire Statistics. Boise, ID: U.S. Dept. of Agriculture,

- U.S. Dept. of the Interior. National Fire and Aviation Executive Board. Federal Fire Policy Directives Task Group. <http://www.nifc.gov/stats/wildlandfirestats.html>
- Nintzel, J. 2005. Broken trust – Saving some patches of our vanishing desert depends on state land reform. Just don't expect to see that happen anytime soon. Tucson Weekly. 3 Mar. <http://www.tucsonweekly.com/gbase/currents/Content?oid=oid:66288>
- Northern Economics. 2002. Social assessment of the Beaverhead-Deerlodge National Forest: A report to the Beaverhead-Deerlodge National Forest. Northern Economics Inc., Anchorage, AK. 425p.
- Office of the President. 2002. Healthy forests: An initiative for wildfire prevention and stronger communities. Washington, DC. 21p. http://www.whitehouse.gov/infocus/healthyforests/Healthy_Forests_v2.pdf
- Omi, P.N., and E.J. Martinson. 2002. Effect of fuels treatment on wildfire severity. Final report to the Joint Fire Science Program Governing Board. Fort Collins, CO: Western Forest Fire Research Center.
- Otterstrom, S., and J.M. Shumway. 2003. Deserts and oases: The continuing concentration of population in the American Mountain West. Journal of Rural Studies. Forthcoming. <http://www.geog.byu.edu/shumway/pubs/Rural%20Studies%20article.pdf>
- Partnership for Community Development. 2000. The Arizona Factbook of Ethnic Minorities. College of Human Services, Arizona State University West. 57 p. <http://www.west.asu.edu/chs/partdev/Ethnic/Ethnic.pdf>
- Peart, D. (Dir.). 1995. Arizona Comparative Environmental Risk Project (ACERP). Arizona State University, Earthvision. <http://earthvision.asu.edu/acerp/>
- Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics. 52:273-288. http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VDY-4F4H9SX-3&_coverDate=02%2F15%2F2005&_alid=262573837&_rdoc=1&_fmt=&_orig=search&_qd=1&_cdi=5995&_sort=d&_view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=62eb55db6ee665a5355632ea17eb34b9
- Pinal County. 2001. Pinal County Comprehensive Plan. 88p. <http://www.co.pinal.az.us/PlanDev/PDCP/CPInfo.asp>
- Pitzl, M.J. 2005. A rocky situation: Plan swaps prized land for mining. Arizona Daily Republic. 18 Apr. <http://www.friendsofqueenecreek.com/AZ%20Rep%20050418%20Rocky%20Situation.htm>
- Pontius, D. 1997. Colorado River Basin study. Report to the Western Water Policy Review Advisory Commission. Tucson, AZ: SWCA Environmental Consultants. 126p. <https://repository.unm.edu/handle/1928/368>
- Provan, K.G., and H.B. Milward. 2001. Do networks really work? A framework for evaluating public-sector organizational networks. Public Administration Review. 61(4):414-423. <http://www.ingentaconnect.com/content/bpl/puar/2001/00000061/00000004/art00005>

- Pyne, S.J. 1997. *Fire in America: A Cultural History of Wildland and Rural Fire*. University of Washington Press, Seattle, WA. 654 pp.
- Rasker, R. 2000. Your next job will be in services—Should you be worried? *Chronicle of Community*. 3(2):38-42.
- Renzi, R. 2005. Southeast Arizona Land Exchange and Conservation Act of 2005. H.R. 2618. 109th Congress, 1st Session. 25 May. <http://www.theorator.com/bills109/hr2618.html>
- Richard, T., and S. Burns. 1998. Beyond “scoping”: Citizens and San Juan National Forest managers, learning together. *Journal of Forestry*. 96(4):39-43.
- Riske, P. 2005. Talk of trust land reform resurfaces – Flake says open space is “deal-breaker.” *Arizona Capitol Times*. 18 Mar.
- RoperASW. 2004. Outdoor recreation in America 2003: Recreation’s benefits to society challenged by trends. Recreation Roundtable. 22p. www.funoutdoors.com/files/ROPER%20REPORT%202004_0.pdf
- Roth, M. 2005. Personal Communication. Acting Recreation Program Leader. Coronado National Forest, Santa Catalina Ranger District.
- Ruyle, G. B., R. Tronstad, D. W. Hadley, P. Heilman, and D. A. King. 2000. Aspects of cattle ranching in Arizona, pp. 379-417. *In* R. Jemison, C. Raish, and D. Finch, *Ecological, Cultural, and Socioeconomic Aspects of Livestock Management in the Southwest*. Elsevier Science Press. 612p.
- Schuster, E.G., and M.A. Krebs. 2003. Forest Service programs, authorities, and relationships: A technical document supporting the 2000 USDA Forest Service RPA Assessment. Gen. Tech. Rep. RMRS-GTR-112. Fort Collins, CO: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station. 88p. http://www.fs.fed.us/rm/pubs/rmrs_gtr112.html
- Segee, B. and M.Taylor. 2002. Prelude to catastrophe: recent and historic land management within the Rodeo-Chediski fire area. Center for Biological Diversity, Sierra Club, Southwest Alliance. http://www.biologicaldiversity.org/swcbd/Programs/fire/r-c_report.pdf
- Sheridan, T.E. 1995. *Arizona: A History*. University of Arizona Press, Tucson. 434p.
- Sherwood, R. 2005. State trust land reform falls apart. *The Arizona Republic*. 22 Feb. <http://www.azcentral.com/specials/special12/articles/0222trustland.html>
- Sherwood, R., and S. McKinnon. 2005. Trust-land reform may go to voters. *The Arizona Republic*. 9 Mar.
- Siggerud, K. 2002. Highway infrastructure – Physical conditions of the Interstate Highway System have improved, but congestion and other pressures continue. Statement by the Acting Director of Physical Infrastructure Issues, U.S. General Accounting Office. 19p. <http://www.gao.gov/new.items/d021128t.pdf>
- Silberman, J. 2003. The economic importance of off-highway vehicle recreation: Economic data on off highway recreation for the state of Arizona and for each Arizona county. Arizona State University West. 90p. http://www.gf.state.az.us/pdfs/w_c/OHV%20Report.pdf

- Stevenson, W.B., and D. Greenberg. 2000. Agency and social networks: Strategies of action in a social structure of position, opposition, and opportunity. *Administrative Science Quarterly*. 45:651-678. <http://www.jstor.org/view/00018392/di015548/01p0021f/0>
- Stokowski, P.A., and C.B. LaPointe. 2000. Environmental and social effects of ATVs and ORVs: An annotated bibliography and research assessment. University of Vermont School of Natural Resources. 31p. http://forestwatch.org/orv/VT_ATV_Study.pdf
- Stuebner, S. 1998. Private rights vs. public lands: Thousands of inholdings create conflict inside federal lands. *High County News*. 30(3). http://www.hcn.org/servlets/hcn.PrintableArticle?article_id=3946
- Sztompka, P. 1993. *The Sociology of Social Change*. Blackwell Publishers, Oxford. 369p.
- Tonto National Forest (TNF). 2005. Schedule of Proposed Action (SOPA) - 01/01/2005 to 03/31/2005. U.S. Dept. of Agriculture. Tonto National Forest. http://www.fs.fed.us/r3/tonto/projects/PA_schedules/jan05/SPA0105-0305.pdf#xml=http://www.fs.fed.us/cgi-bin/taxis/searchallsites/search.allsites/xml.txt?query=Tonto+%28SOPA%29+2005&db=allsites&iid=424898480
- Toupal, R.S. 2003. Cultural landscapes as a methodology for understanding natural resource management impacts in the western United States. *Conservation Ecology*. 7(1). <http://www.ecologyandsociety.org/vol7/iss1/art12/main.html>
- United States Census Bureau. 2005. United States Census, 2000. U.S. Dept. of Commerce. <http://www.census.gov/>
- United States Department of Agriculture (USDA). 1997. Departmental Regulation on Environmental Justice. Dept. Reg. No. 5600-002 National Resource Conservation Center. Washington, D.C. <http://www.nrcs.usda.gov/technical/ECS/environment/envjust.html>
- United States Department of Agriculture (USDA). 2002. *Agricultural Fact Book, 2001-2002*. Office of Communication. 174p. <http://www.usda.gov/factbook/>
- United States Fish and Wildlife Service (USFWS). 2001. National Survey of Fishing, Hunting, and Wildlife Associated Recreation. In conjunction with U.S. Dept. of the Interior (DOI), U.S. Dept. of Commerce, U.S. Census Bureau. <http://www.census.gov/prod/2002pubs/FHW01.pdf>
- United States Forest Service (USFS). 1982. *ROS Users Guide (FSM 2311)*. Recreation, Heritage, and Wilderness Resources. Washington, DC. 38p.
- United States Forest Service (USFS). 1983. *Facts about the National Forest System in the Southwest*. Southwestern Region, Albuquerque.
- United States Forest Service (USFS). 1985. *Tonto National Forest Plan*. U.S. Dept. of Agriculture, Southwest Region. Phoenix, AZ. 253p.
- United States Forest Service (USFS). 1993. *The Principal Laws Relating to Forest Service Activities*. U.S. Government Printing Office. Washington, D.C. 1,163p.

- United States Forest Service (USFS). 1995. Landscape aesthetics: A handbook for scenery management. Agriculture Handbook 701. 264 pp.
- United States Forest Service (USFS). 1999a. Heber-Overgaard Interface Analysis. Apache Sitgreaves National Forests, Chevelon-Heber Ranger District. CEEM V Team. 80p.
- United States Forest Service (USFS). 2000a. RPA Assessment of forest and range lands. FS 687. Washington, DC. 78p. <http://www.fs.fed.us/pl/rpa/rpaasses.pdf>
- United States Forest Service (USFS). 2000b. Interim strategic public outreach plan. FS-665. U.S. Dept. of Agriculture. 51p. http://www.fs.fed.us/cr/national_programs/correspondence/spop/fsspop.pdf
- United States Forest Service (USFS). 2001b. Santa Rita Experimental Forest. Rocky Mountain Research Station. <http://www.fs.fed.us/rm/main/expfor/santarita.html>
- United States Forest Service (USFS). 2001c. Roadless Area Conservation. U.S. Dept. of Agriculture. <http://roadless.fs.fed.us/>
- United States Forest Service (USFS). 2001e. The built environment image guide. FS-710. U.S. Dept. of Agriculture. 275p. <http://www.fs.fed.us/recreation/programs/beig/>
- United States Forest Service (USFS). 2002a. Environmental assessment: East Clear Creek watershed health project. Mogollon Rim Ranger Station, Coconino National Forest, Coconino County, AZ. 114p. http://www.fs.fed.us/r3/coconino/nepa/east_clearcreek_ea.pdf
- United States Forest Service (USFS). 2003a. Coconino National Forest Off-Highway Vehicle Proposed Forest Plan Amendment. Southwestern Region. 6p. <http://www.fs.fed.us/r3/ohv/deis/cocamend.pdf>
- United States Forest Service (USFS). 2003c. Draft environmental impact statement for cross country travel by off-highway vehicles: Apache-Sitgreaves, Coconino, Kaibab, Prescott, and Tonto National Forests, Arizona. Southwestern Region. 201p. <http://www.fs.fed.us/r3/ohv/deis/xcountry-deis.pdf>
- United States Forest Service (USFS). 2003d. Draft environmental impact statement for the Rodeo Chediski Fire Salvage Project: Apache-Sitgreaves and Tonto National Forests. Southwestern Region. 363p. http://www.fs.fed.us/r3/asnf/salvage/publications/RodeoChediski_DEIS.pdf
- United States Forest Service (USFS). 2003f. Understanding community-forest relations. Gen. Tech. Rep. PNW-GTR-566. Portland, OR: U.S. Dept. of Agriculture, Pacific Northwest Research Station. 162p. <http://www.fs.fed.us/pnw/pubs/gtr566.pdf>
- United States Forest Service (USFS). 2003g. Decision Memo Categorical Exclusion, Bellemont Land Exchange. 20 Feb. http://www.fs.fed.us/r3/coconino/nepa/2003/final_d_m_bellemont.pdf#xml=http://www.fs.fed.us/cgi-bin/taxis/searchallsites/search.allsites/xml.txt?query=bellemont+land+exchange+coconino+national+forest&db=allsites&id=42495dcc0
- United States Forest Service (USFS). 2004d. Forest insect and disease conditions in the Southwestern Region, 2003. R3-04-02. Southwestern Region, Forestry and Forest Health. 34p. <http://www.fs.fed.us/r3/publications/documents/fidc2003.pdf>

- United States Forest Service (USFS). 2004g. 36 CFR Part 294 Special Areas; State Petitions for Inventoried Roadless Area Management. U.S. Dept. of Agriculture. Federal Register. 69:42636-42641.
- United States Forest Service (USFS). 2004j. Travel management: Designated routes and areas for motor vehicle use (proposed rule). Federal Register. 69(135):42381-42395.
- United States Forest Service (USFS). 2004n. Fact sheet: Loss of open space. U.S. Dept. of Agriculture. 1p. <http://www.fs.fed.us/projects/four-threats/documents/lossofopenspace-fs.pdf>
- United States Forest Service (USFS). 2004o. Fact sheet on Arizona bark beetle epidemics. Southwest Region. 2p. http://www.fs.fed.us/r3/resources/health/documents/az_2004_beetle.pdf
- United States Forest Service (USFS). 2005c. National Forest System land management planning: Final rule. 36 CFR Part 219. Federal Register. 70(3):1023-1034.
- United States Forest Service (USFS). 2005d. Record of decision: Final environmental impact statement for integrated treatment of noxious or invasive weeds: Coconino, Kaibab, and Prescott National Forests within Coconino, Gila, Mojave, and Yavapai Counties, Arizona. Southwest Region. 14p. http://www.fs.fed.us/r3/kai/projects/nox_weeds/pds/feis-chapters.pdf
- United States Forest Service (USFS). 2005f. Loss and fragmentation of open space. Forest Service Policy Position Paper. 5p. <http://www.fs.fed.us/publications/policy-analysis/loss-of-open-space-position-paper.pdf>
- United States Forest Service (USFS). 2005g. Sold and harvest reports for all convertible products. U.S. Dept. of Agriculture, Forest Management. <http://www.fs.fed.us/forestmanagement/reports/sold-harvest/index.shtml>
- United States Forest Service (USFS). 2005i. NFS mineral production summary, fiscal year 2003. U.S. Dept. of Agriculture, Forest Management http://www.fs.fed.us/geology/mgm_locatable.html
- United States Forest Service (USFS). 2005j. Four threats—quick facts—unmanaged recreation. U.S. Dept. of Agriculture, Forest Service Website. <http://www.fs.fed.us/projects/four-threats/facts/unmanaged-recreation.shtml>
- United States Forest Service (USFS). 2005n. Mission, motto, vision, and guiding principles. U.S. Dept. of Agriculture, Forest Service Website. <http://www.fs.fed.us/aboutus/mission.shtml>
- United States Forest Service (USFS). 2005o. National Forest System Land Management Planning (Final Rule). U.S. Dept. of Agriculture. Federal Register 70(3):1023-1061. <http://www.nplnews.com/library/forestplanning/2004rule.htm>
- United States Forest Service (USFS). 2005q. Forest health protection. Forest Service Website. <http://www.fs.fed.us/foresthealth>
- United States Geological Survey (USGS). 2004. Climatic fluctuations, drought, and flow in the Colorado River Basin (v. 2). USGS Fact Sheet 2004-3062. U.S. Dept. of the Interior. 4p. http://water.usgs.gov/pubs/fs/2004/3062/pdf/fs2004-3062_version2.pdf
- Vincent, C.H. 2004. Grazing fees: An overview and current issues. CRS Report RS-21232. Congressional

- Research Service, Library of Congress. 6p.
<http://www.ncseonline.org/NLE/CRS/abstract.cfm?NLEid=60589>
- Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo. 1997. Human domination of Earth's ecosystems. *Science*. 277: 494-499. <http://www.rachel.org/library/getfile.cfm?ID=200>
- Western Lands Group, Inc. (WLG). 2005. Western Land Group Completes Diamond Point Land Exchange. <http://www.westernlandgroup.com/Diamond%20Point.htm>
- Wilkinson, C.F. 1992. *Crossing the Next Meridian: Land, Water and the Future of the West*. Island Press, Washington, DC. 389p.
- Williams, D.R., and M.E. Patterson. 1996. Environmental meaning and ecosystem management: Perspectives from environmental psychology and human geography. *Society and Natural Resources*. 9:507-521.
- Williams, D.R., and S.I. Stewart. 1998. Sense of place: An elusive concept that is finding a home in ecosystem management. *Journal of Forestry*. 96(5):18-23.
- Wink, R.L., and H.A. Wright. 1973. Effects of fire on an Ashe juniper community. *Journal of Range Management*. 12:153-167.
- Wolff, P. 1999. The taxpayer's guide to subsidized ranching in the Southwest. Center for Biological Diversity, Tucson, AZ. 24p. <http://www.biologicaldiversity.org/swcbd/programs/grazing/tax.pdf>
- Wondolleck, J.M., and S.L. Yaffee. 2000. *Making Collaboration Work: Lessons from Innovation in Natural Resource Management*. Island Press, Washington, D.C. 277p.
- Wright, H.A., and A.W. Bailey. 1982. *Fire Ecology: United States and Southern Canada*. John Wiley & Sons, New York. 501 pp.
- Yavapai County. 2003. Yavapai County General Plan. Dava Associates Inc. 80p.
<http://www.co.yavapai.az.us/departments/Dev/unitspc/ordregs/genplan/2003gp.pdf>

Appendix A. Industry Sectors for IMPLAN Data Analysis

Income from wood products and processing	
NAICS Sector	
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.

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

Tourism employment*	
NAICS Sector	
Retail	
449	General Merchandise Stores
450	Food Stores
451	Automotive Dealers and Service Stations
452	Apparel & Accessory Stores
455	Miscellaneous Retail
Restaurant / Bar	
454	Eating and drinking
Lodging	
463	Hotels and lodging places
477	Automobile Rental and Leasing
Amusements	
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 Tonto National Forest

Output, Value Added and Employment

July 26, 2005

Base Year: 2002

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Industry	Industry		Employee	Proprietor	Other Property	Indirect	Total
	Output*	Employment	Compensation*	Income*	Income*	Business Tax*	Value Added*
1 11 Ag, Forestry, Fish & Hunting	1,383.852	13,669.385	255.555	155.897	46.876	33.653	491.981
19 21 Mining	1,096.174	6,035.368	216.032	25.184	225.354	48.012	514.582
30 22 Utilities	3,543.073	7,650.407	691.804	50.887	1,195.638	382.510	2,320.838
33 23 Construction	22,162.874	185,890.652	6,893.726	1,638.630	983.429	112.984	9,628.768
46 31-33 Manufacturing	32,149.854	144,985.806	8,638.221	456.676	3,197.206	262.438	12,554.540
390 42 Wholesale Trade	12,514.288	85,561.797	4,804.475	211.791	1,963.400	2,080.631	9,060.296
391 48-49 Transportation & Warehousing	8,164.116	73,249.730	3,068.994	267.151	480.946	234.362	4,051.453
401 44-45 Retail trade	14,744.823	237,425.708	6,014.209	716.780	2,190.822	2,141.752	11,063.563
413 51 Information	7,667.531	43,237.966	2,022.537	246.917	1,545.896	416.107	4,231.457
425 52 Finance & insurance	19,324.016	129,919.327	5,638.308	491.161	4,090.959	540.043	10,760.471
431 53 Real estate & rental	20,924.417	107,633.552	1,551.852	1,658.513	9,358.765	1,892.611	14,461.741
437 54 Professional- scientific & tech svcs	11,600.290	137,511.436	5,527.455	1,698.170	1,262.482	142.428	8,630.535
451 55 Management of companies	2,508.673	18,575.695	1,156.356	20.018	517.982	27.443	1,721.799
452 56 Administrative & waste services	8,560.811	184,840.828	4,457.190	411.132	596.636	132.325	5,597.283
461 61 Educational svcs	1,272.768	24,966.982	644.766	21.128	81.500	19.751	767.146
464 62 Health & social services	12,619.787	162,198.503	6,167.445	695.694	831.817	96.426	7,791.383
475 71 Arts- entertainment & recreation	2,253.890	41,819.745	868.771	213.878	170.224	154.540	1,407.413
479 72 Accommodation & food services	6,829.475	154,706.634	2,525.649	156.665	552.856	370.969	3,606.139
482 81 Other services	6,736.065	141,999.153	2,833.786	380.444	157.372	73.925	3,445.527
495 92 Government & non NAICs	24,890.297	236,683.454	10,257.434	0.000	10,125.038	1,201.366	21,583.837
Totals	220,947.076	2,138,562.129	74,234.565	9,516.716	39,575.196	10,364.276	133,690.754

*Millions of dollars