

Assessing Interconnections Between Wilderness and Adjacent Lands: The Grand Staircase-Escalante National Monument, Utah

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Abstract—Wilderness managers have traditionally managed wilderness lands based on the ecological and social content of wilderness areas. The authors propose a framework to systematically account for the biophysical, socioeconomic, and wilderness characteristics of the broader landscape context. The method was applied to the proposed wilderness lands of the Grand Staircase-Escalante National Monument in southern Utah. The results illustrate patterns of interdependencies across the landscape. Spatial data demonstrate links between the integrity of proposed wilderness lands and the management of adjacent land units, and links between the economic health of local communities and the management of proposed wilderness and adjacent federal lands.

Wilderness carries with it a variety of valued characteristics and management goals. The Wilderness Act of 1964 describes wilderness with such phrases as “untrammeled by man,” “retaining its primeval character and influence,” and “affected primarily by the forces of nature.” Cole (1996) cites three reasons for the importance of wilderness: to protect the natural ecosystem and the life forms within it, to provide a scientific baseline for comparison with other landscapes, and to provide recreational, spiritual and other human values.

Managing lands with these ideas in mind is challenging, to say the least. Traditionally, wilderness management has focused on the protection of the content of ecosystems within the boundaries of a wilderness unit. Yet, wilderness areas share boundaries with other lands with differing management objectives. These boundaries at once divide and link the land units (Landres 1998), as well as the people managing and using these lands.

Management activities can have significant ecological effects across ownership or management boundaries. Landres

and others (1998) emphasize four points regarding ecological impacts across borders: “1) Management goals and actions are the primary cause of boundary effects; 2) altered flows either into or out of an area will likely be detrimental to that area; 3) boundary effects follow a distinct temporal sequence; and 4) once established, these effects may have long-term and far-reaching consequences that are difficult or impossible to overcome.” These issues are further complicated by social effects (Brunson 1998) and policies (Meidinger 1998) across ownership boundaries.

Achieving management goals within wilderness areas requires identifying interactions and interdependencies across multiple land units. The goal of this work was to develop a set of landscape characteristics data and use it to test two points: 1) how is the integrity of wilderness areas affected by surrounding lands and 2) how are surrounding communities affected by wilderness areas. The assessment was applied to the proposed wilderness areas of the Grand Staircase-Escalante National Monument and surrounding landscape of southern Utah and northern Arizona.

Study Area

The Grand Staircase-Escalante National Monument lies in a region of arid canyons and high, forested plateaus in southern Utah and northern Arizona (fig. 1). The Monument is centered in an ecosystem we refer to as the “Crown of the Canyons,” which is defined by the Escalante and Paria River watersheds and upper Kanab Creek watershed. The area includes the headwater regions of the Paunsaugunt and Aquarius Plateaus and reaches south to the edges of Lake Powell and the Colorado River. The Crown of the Canyons lies in a still broader region encompassing the Dixie National Forest to the north, Grand Canyon National Park to the south, Glen Canyon National Recreation Area to the east and Zion National Park to the west (fig. 2).

This broad region sets the context for the Monument’s wilderness resources and encompasses a diversity of natural and human resources. With elevations ranging from deserts at 1,000 feet to 12,000-foot forested plateaus, the study area provides a diversity of habitats for a high number of individual species (Belnap 1998). It includes the Colorado River and some of its major tributaries that have water diverted from the natural flow for human uses. The region includes a host of other federal, state, private and Native American

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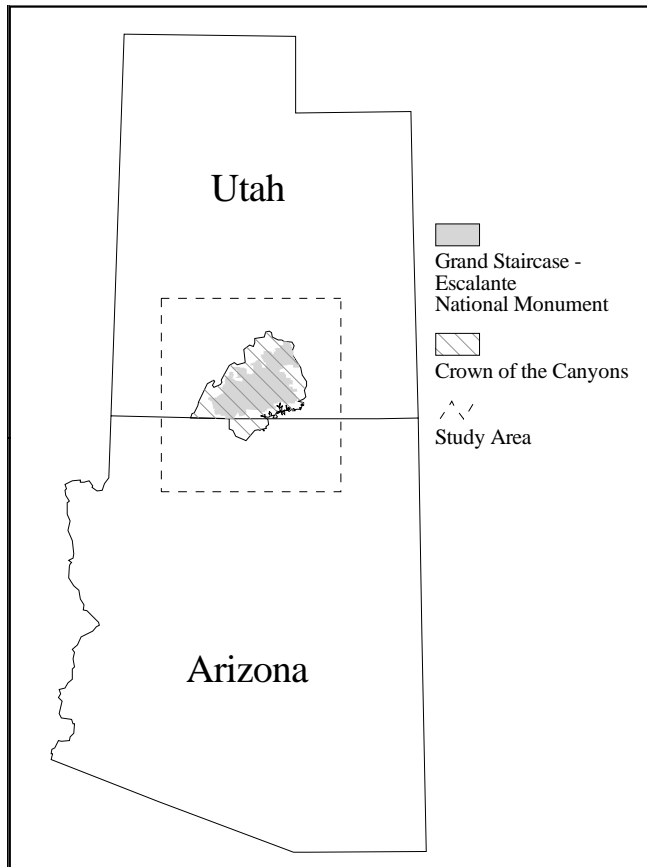


Figure 1—Index map. The proposed wilderness lands of Grand Staircase-Escalante National Monument fall within the Crown of the Canyons watershed-based region which is in turn bounded by a broader study area boundary.

lands whose owners and users can potentially impact wilderness lands within the Monument. While the land is sparsely populated, there are communities throughout the region that use natural resources for traditional extractive industries and amenity-based activities as well.

The Grand Staircase-Escalante National Monument, established under the USDI Bureau of Land Management in the fall of 1996, encompasses 1.9 million acres of land. Of that total, 1.6 million acres are proposed for wilderness designation by the Utah Wilderness Coalition and are shown in figure 3. An assessment of the surrounding lands and the Monument is needed to develop sound management practices if the wilderness qualities of the area are to be maintained.

Methods

Landscape Characteristics

The first step in assessing the content and context of wilderness lands is to determine the landscape features that significantly affect wilderness. We describe these in three categories: biophysical, socioeconomic and wild.

In an effort to simplify the complexity of the biological and physical landscape, we selected biophysical factors from

the “state factor model” presented by Jenny (1941). Jenny’s model uses climate, organisms, relief, soil parent material and time since the last disturbance to determine the condition of an ecosystem. While not providing the most complete description, it lays out constructive elements and processes in the landscape that may be represented by readily available spatial data.

The social and economic features of the landscape are just as important as the ecological factors to the future of wilderness lands. As Freyfogle (1998) says, “To talk of the health of such a land community is to include necessarily the health of the resident people and their social and economic enterprises.” In the western United States, where historical dependence on natural resources for employment has dropped from 85% in 1810 to 5% today (Power 1996), the description of the economy must look far beyond traditional extractive industries. Knowledge-based and service-based industries need to be considered in a regional economic development model. Landscape data need to represent diverse social and economic factors and illustrate their relationship to wilderness lands. Features of the socioeconomic landscape include land tenure, income and employment, with special attention paid to the natural resource based economy.

Many different characteristics affect the degree of landscape wildness and are not easily measured. In contrast to a characterization of wildness simply as the absence of management, Aplet (1999), describes wildness as consisting of two distinct components: 1) the freedom from human control, and 2) naturalness, the degree to which the land retains its primeval character. According to Aplet and others (this volume) attributes of the land that contribute to its freedom from control are: “1) the degree to which land provides opportunities for solitude; 2) the remoteness of the land from mechanical conveyance; and 3) the degree to which ecological processes remain uncontrolled by human agency. The attributes that contribute to naturalness of the land are: 1) the degree to which it maintains natural composition; 2) the degree to which it remains unaltered by artificial human structure; and 3) the degree to which it is unpoluted.” Because of the difficulty of mapping the degree of control of ecological processes, we limited our analysis to five of these six attributes of wildness.

Geographic Information Systems Data

A GIS was used to provide the needed spatial perspective for the biophysical, socioeconomic and wildness features. Data layers were collected and used as is or were generated from standard GIS methods from readily available GIS or tabular data. The work was conducted and products generated with Arc/Info GIS software.

GIS data collected for the study are readily available from state and federal agencies. The benefit of this is that similar data are also available for work applied to other wilderness areas. The drawback is that data that ideally represent each landscape feature are not always available. In addition, because the GIS data come from disparate sources, they vary in scale, spatial extent and intended purpose. We made every effort to use each data set within its inherent limitations.

Table 1 lists the landscape features for the biophysical, socioeconomic and wildness categories. For each feature, a

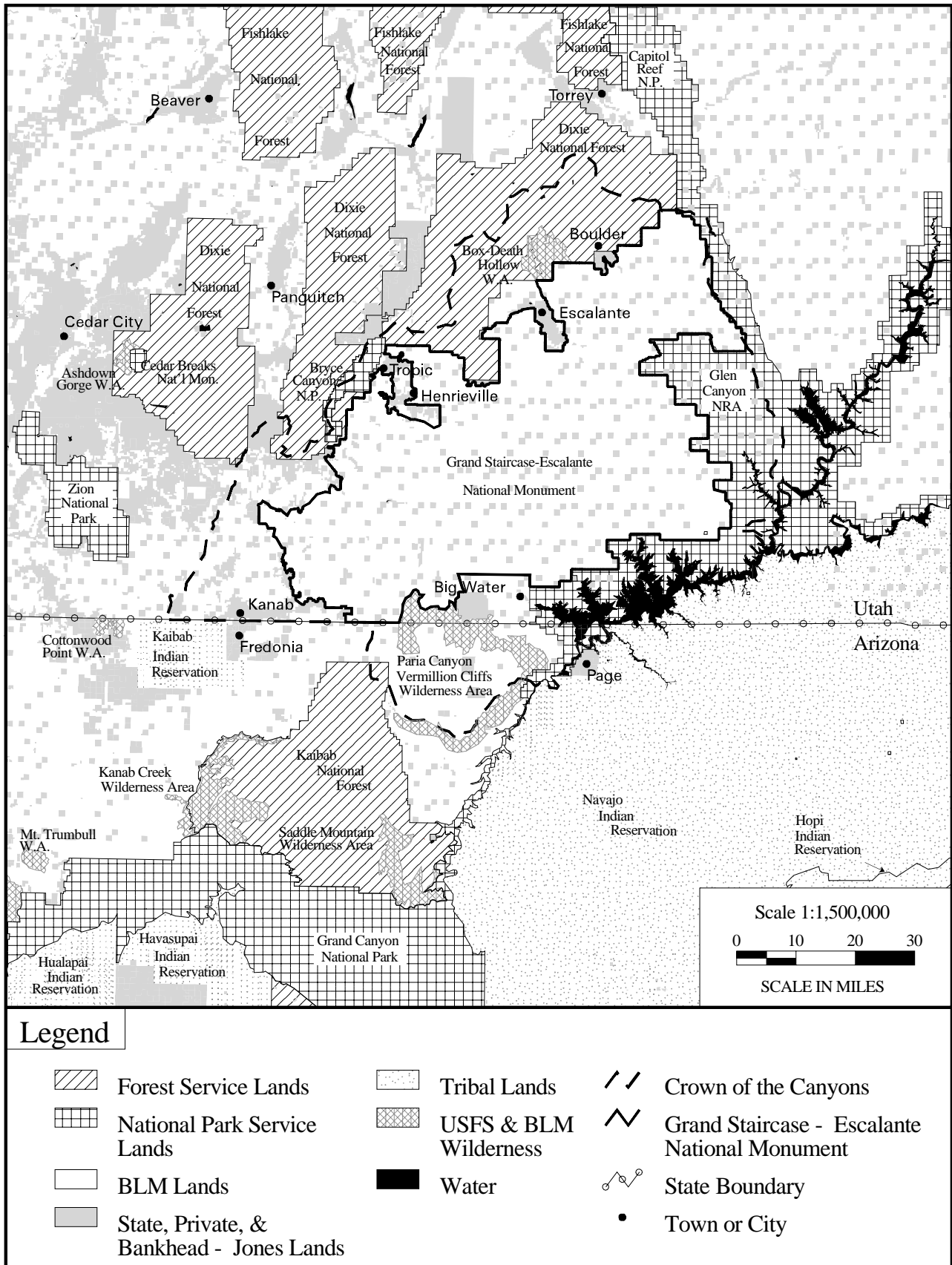


Figure 2—Socioeconomic landscape characteristic map: Land Tenure. The study area has abundant public lands requiring coordinated management by state and federal land management agencies. Note: Due to a 1998 Act of Congress, state lands in the Monument were exchanged for federal lands and mineral leases elsewhere.

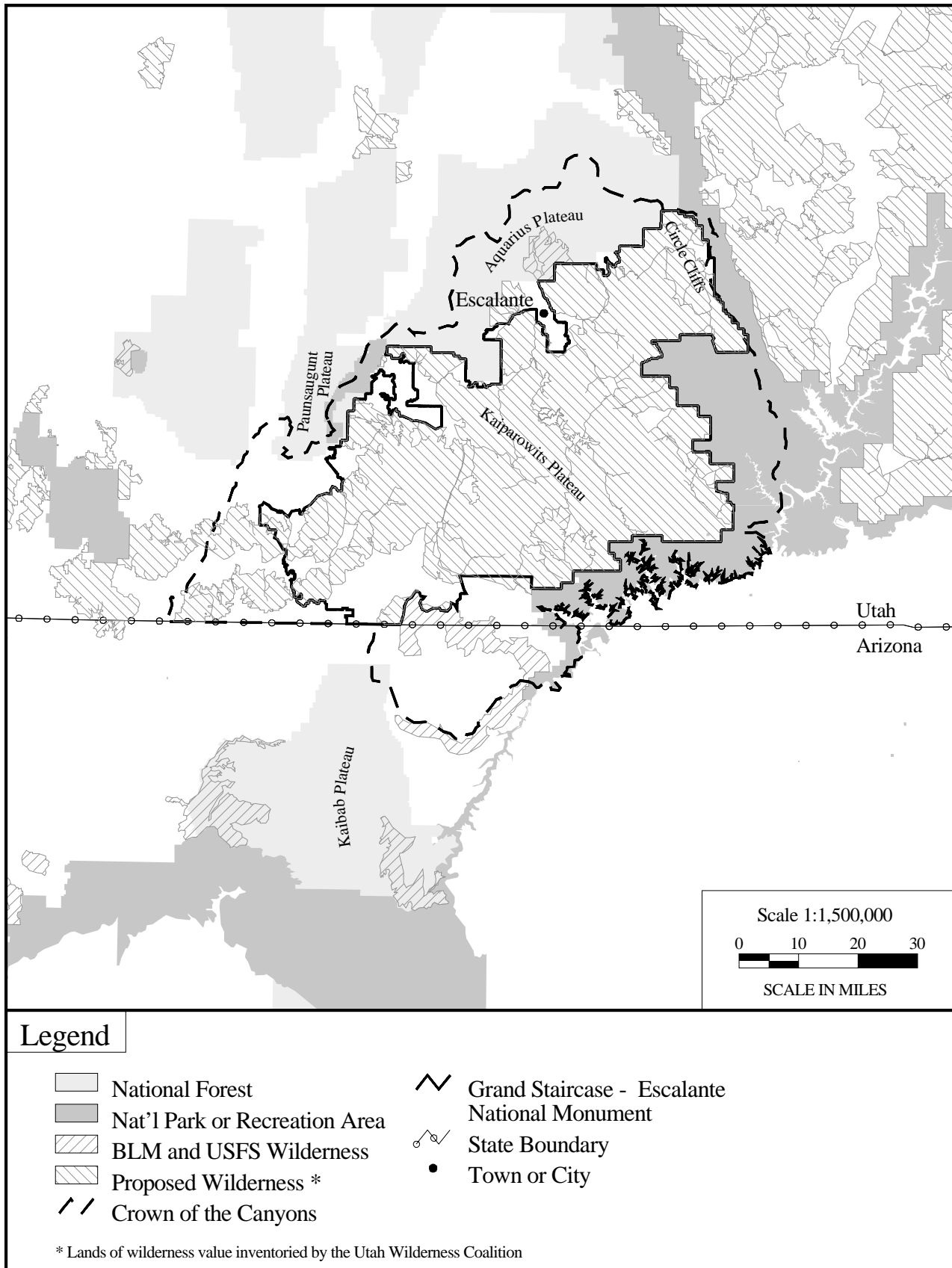


Figure 3—Potential wilderness lands map. The potential wilderness lands discussed in this paper refer to lands within the Grand Staircase-Escalante National Monument with high wilderness value inventoried by the Utah Wilderness Coalition (UWC). The UWC inventory extends across all Bureau of Land Management lands in Utah.

Table 1—A spatial assessment of the Grand Staircase-Escalante study area was made using three major categories of landscape information and selected features contributing to each category.

Category	Feature
Biophysical	Relief
	Parent material
	Climate
	Organisms
	Disturbance
Socioeconomic	Land tenure
	Income
	Employment & earnings
	Mining
	Agriculture
	Recreation & tourism
	Timber
	Government
Wildness	Solitude
	Remoteness
	Unaltered processes
	Natural composition
	Unaltered structure
	Pollution

GIS data layer or layers were collected or generated. Admittedly, each feature listed could involve an exhaustive study of its complexity and variability across the study area. The attempt here, however, was to generate a spatial data set for each feature that would provide a single, if rough, representation of the feature to place the wilderness lands in context.

A series of 20 GIS-based maps were produced and descriptions of results from each are described below with selected maps. A complete set of the color maps and data source list can be found in *Crown of the Canyons, An Atlas of the Ecology, Economy, and Future of the Greater Grand Staircase-Escalante Ecosystem* (Aplet and others 1999), available over the World Wide Web at www.wilderness.org/newsroom/publications.htm.

Results

The Biophysical Landscape

The study area falls within the Colorado Plateau and the Basin and Range physiographic provinces (Allison 1997). Flora in the Monument come from the Great Basin and Arizona deserts, with lesser contributions from the Mojave Desert and the Great Plains (Belnap 1998). Consequently, the biophysical features listed in table 1 vary in complex ways throughout the region. At a regional scale, these can be represented by readily available GIS data that capture important aspects of each feature.

Relief—The elevation ranges from near 1,000 feet along the Colorado River (Lake Powell) to over 11,000 feet on the Aquarius Plateau. The region is dissected by major drainages

and canyons, including the Colorado River, the Escalante River, the Paria River and Kanab Creek. The Monument and its proposed wilderness do not include the high plateau landscapes over 9,000 feet, which occur primarily to the north and west of the Monument on national forest lands.

Parent Material—The landscape's geology is dominated by sedimentary rocks that become progressively older to the south. The Monument is dominated by Mesozoic sedimentary rocks and contains abundant fossil beds, coal deposits and unique geologic features such as burning coal seams and sandstone arches. (Doelling and others 1998). To the south, the rocks become progressively older, with Precambrian rocks exposed in the Grand Canyon. To the north, the rocks become generally younger, with Tertiary volcanics capping some of the higher plateaus. Protection of wilderness areas in the Monument may preserve not only the unique exposures of Mesozoic sediments and paleontological deposits, but the substrates that support 125 species of rare flora found only in Utah or the Colorado Plateau, of which 11 are found only within the Monument (Belnap 1998).

Climate—Precipitation is strongly correlated with the elevation gradient (fig. 4). Precipitation is less than 10 inches per year over much of the Monument, but reaches 25 to 30 inches per year on the Aquarius and Paunsaugunt Plateaus, headwaters for the Escalante and Paria Rivers and Kanab Creek. Water flow and quality within the proposed wilderness lands of the Monument are therefore dependent on management activities allowed in the adjacent national forest areas, including logging, road-building, off-road vehicle use and water development projects.

Organisms—The diversity of flora and fauna across the study area is difficult to represent in a single GIS data layer. The vegetation data produced by the Utah and Arizona Gap Programs were selected to illustrate the variations in vegetation communities and habitats. Because the Gap Programs from the two states do not use the same vegetation classification schemes, the two data sets were simplified to a common, generalized classification that could be used across both states; yet some edge matching problems persist across the state border.

The vegetation map shows complex patterns that often reflect trends in the relief and climate maps. Vegetation patterns grade from alpine and forested highlands to the northwest to blackbrush and mixed Great Basin desert scrub classes near the Colorado River. Vegetation classes covering the largest spatial extent in the study area are the mixed Great Basin desert scrub and pinyon-juniper forest (fig. 5). South- and southeast-trending drainages break up the northwest-trending gradient in elevation and plant communities. These provide migration corridors across elevation zones within the Monument and across its borders.

Disturbance—Disturbance is challenging to represent with GIS data because the natural and anthropogenic disturbance factors that influence the landscape are insufficiently documented. For this work, the fire disturbance regime was mapped by type and frequency, based on the vegetation data. Within the Monument, fire plays the largest role in the lower elevation grassland areas. Outside the Monument, fire has the largest role in low-elevation grasslands and in the ponderosa pine forests of the Aquarius,

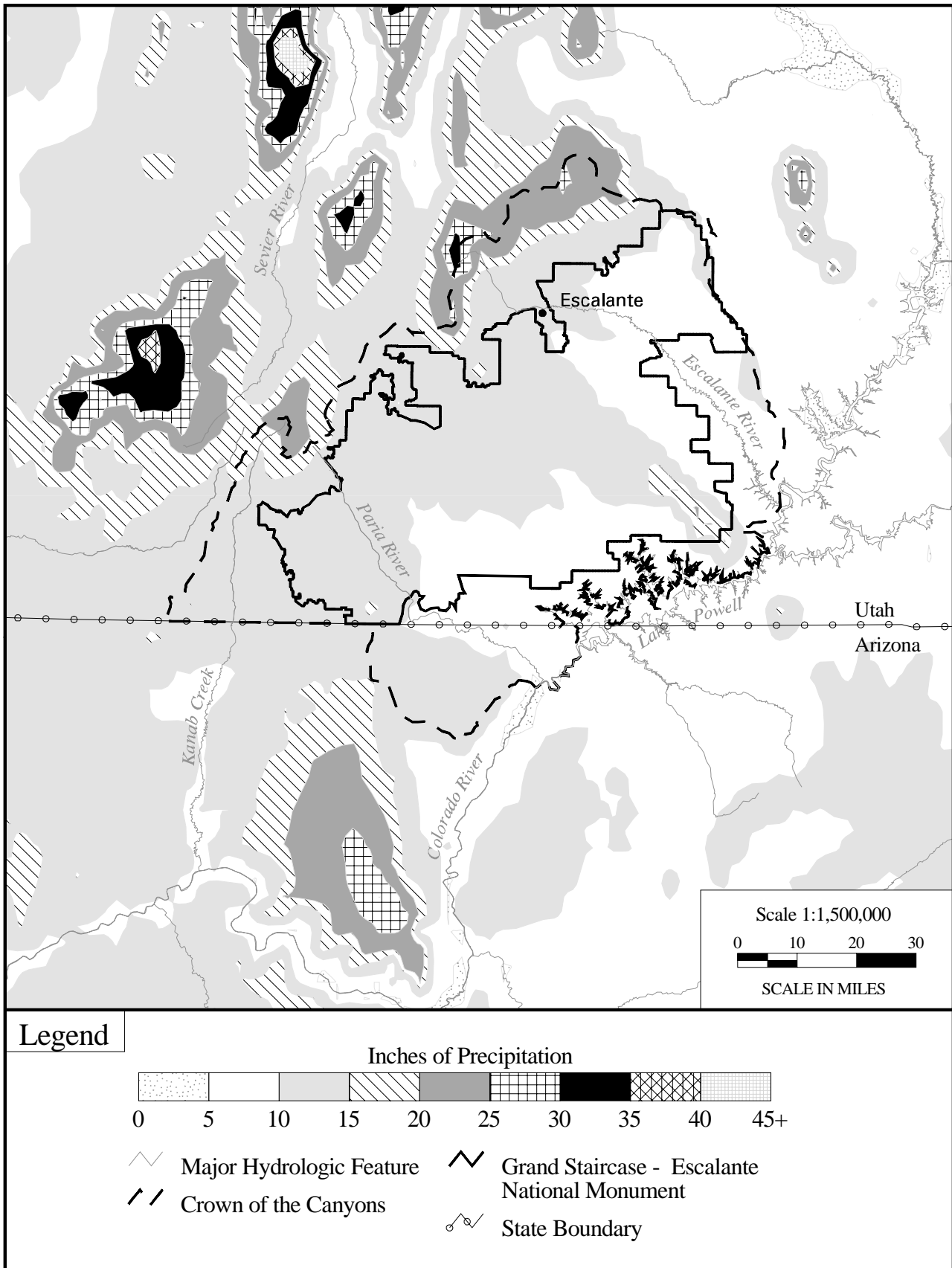


Figure 4—Biophysical landscape characteristic map: Precipitation. The headwaters for the major drainages of the Grand Staircase-Escalante National Monument are in the high precipitation plateaus outside of the Monument. The water flow and quality within the proposed wilderness lands of the Monument depend on management activities allowed in the adjacent national forest lands.

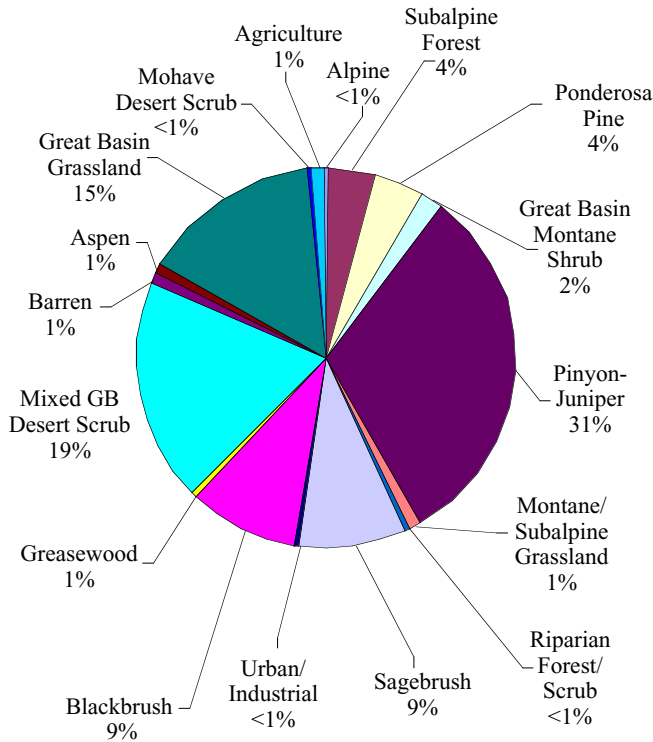


Figure 5—Vegetation classes in the study area.

Paunsaugant and Kaibab Plateaus. Fire suppression in these areas could affect the composition and structure of plant communities.

The Socioeconomic Landscape

The socioeconomic features listed in table 1 reflect several social and economic activities that are common to the landscape in southern Utah and northern Arizona. Assessment features could vary for other wilderness areas.

Land Tenure—The Monument is nested in a landscape dominated by federal lands managed by the Forest Service, National Park Service and BLM (fig. 2). Ninety-six percent of the Crown of the Canyons region is in some form of public ownership. The integrity of proposed wilderness lands within the Monument depends on coordinating management policies and activities of the agencies managing adjacent lands and resources. Private landowners, communities (such as Kanab, Escalante and Boulder) and the Native American Tribes depend on sound, coordinated management of federal lands for amenity resources and ecological services, as well as more traditional uses.

Non-Labor Income—Bureau of Economic Affairs data indicate that non-labor income is the top component of total personal income, accounting for 39% of total personal income in Kane and Garfield Counties in 1995 (fig. 6). Non-labor income, which includes retirement and investment income, acts in the same way as export-derived income by supporting additional jobs in the regional economy. Non-labor income accounts for a greater share of total personal

income in Garfield and Kane Counties than in the state as a whole, reflecting a growing retirement community and more individuals with investment earnings. The spatial display of census data indicates a majority of census block groups in the Crown of the Canyons region receive significant amounts of investment income (fig. 7). Proposed and existing wilderness lands, when combined with surrounding federal lands, can contribute to future community development by sustaining a natural backdrop for amenity-based community development.

Employment—Employment data indicate that the service sector employs more people than other segments of the economy. The service sector is the top employer in 75 of the 117 census block groups mapped, extractive activities (agriculture, mining, forestry) dominate in 14 and retail trade in 11. Other employment sectors such as construction, manufacturing, communication and utilities, and public administration make up relatively smaller portions of the employment landscape. Bureau of Economic Affairs data show a striking trend of increasing employment in the service-related industries (finance, insurance and real estate, wholesale and retail trade and the service sector) in Kane and Garfield counties, accounting for 53% of the total employment in 1995 (fig. 8). This trend is due in part to an increase

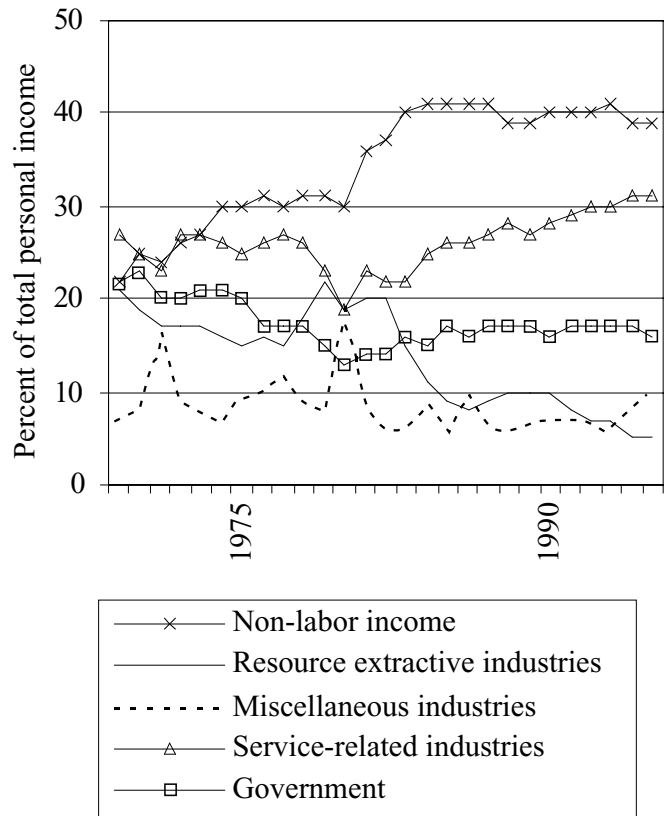


Figure 6—Total personal income (TPI) in Garfield and Kane counties, Utah (1969-1995). Non-labor income, comprised mostly of retirement and investment income, accounts for 39% of TPI. Income from service-related employment has also increased in importance, while resource-extractive industries are declining in relative importance.

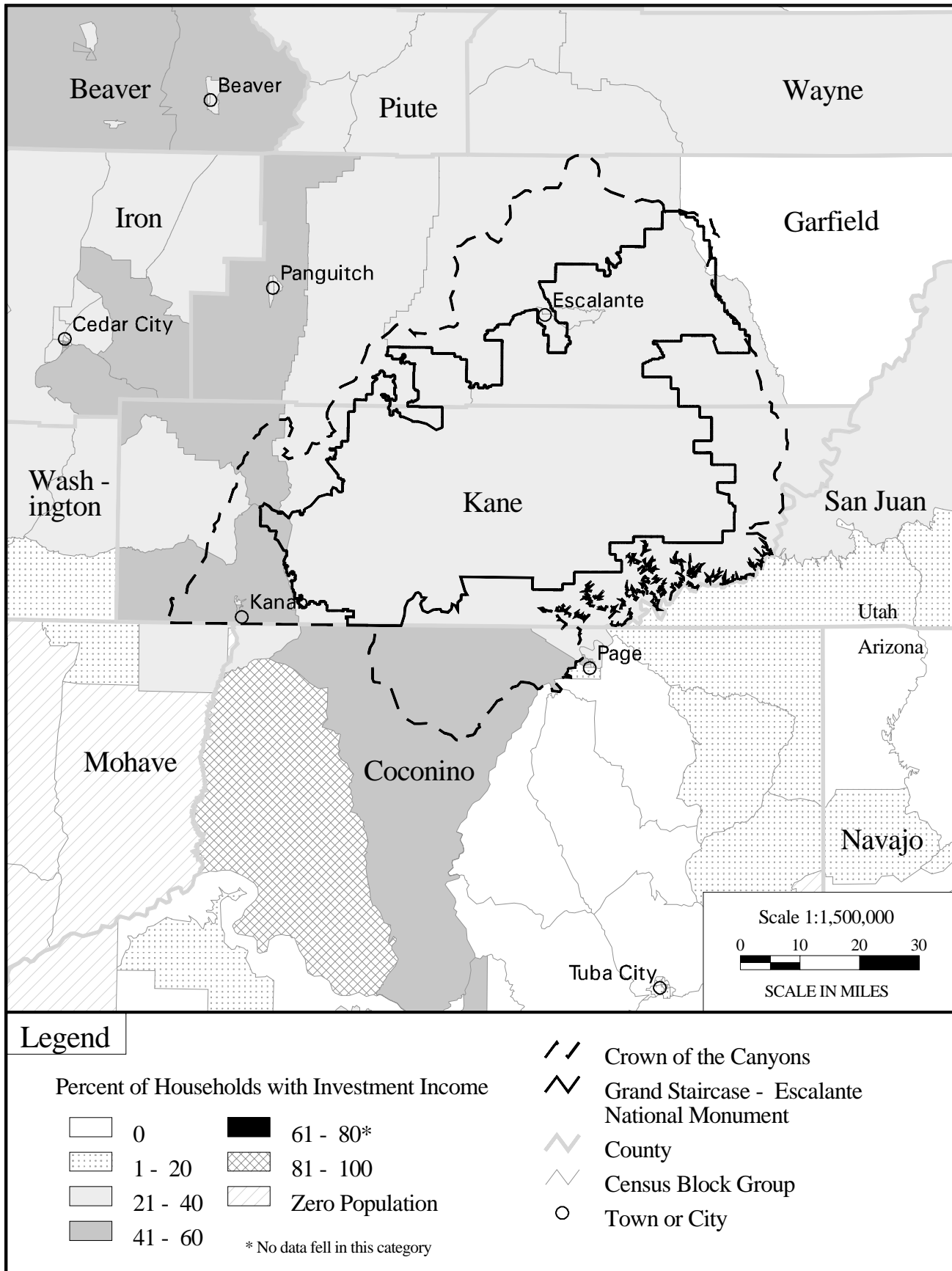


Figure 7—Socioeconomic landscape characteristic map: Income. The percent of households with investment income is mapped by census block. Investments, an important source of nonlabor income, contribute to household income in most census block groups in the region.

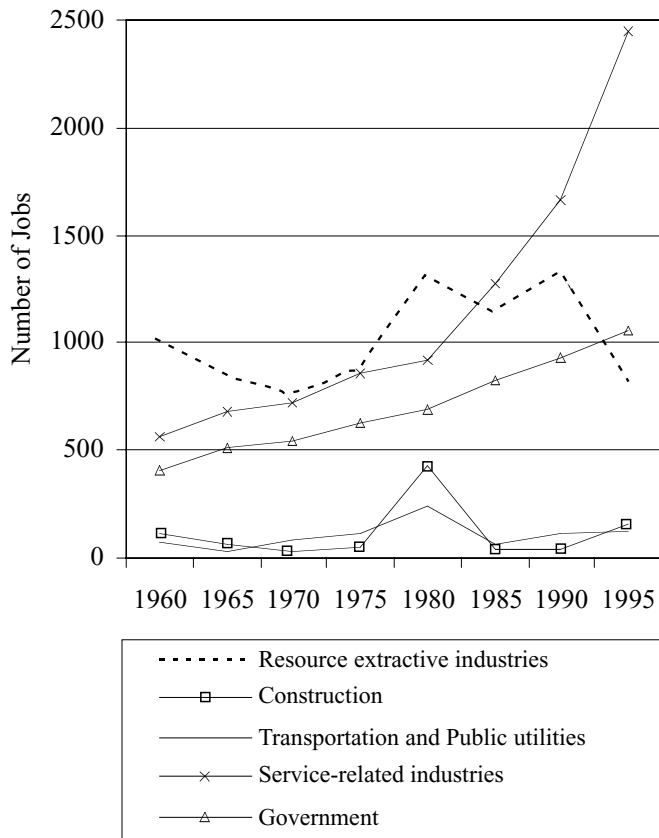


Figure 8—Employment in Kane and Garfield Counties, Utah (1960-1995). Jobs in service-related industries (finance, insurance and real estate, wholesale and retail trade and the service sector) accounted for 53% of total employment in 1995.

in recreation, linking the area's amenity resources to the region's employment sources across the landscape.

Mining—Mineral deposit and lease information was available only for lands within the Monument. Data from the Utah State Geological Survey, the U.S. Bureau of Mines, the Bureau of Land Management and the U. S. Geological Survey show a distribution of deposits across much of the Monument ranging from unexplored deposits to abandoned mines. Geographically notable distributions include concentrations of coal running the length of the Kaparowits Plateau, a concentration of oil and gas wells southeast of Escalante and a concentration of uranium deposits in the Circle Cliffs area. The majority of the deposits are not active. The exploitation of coal, oil or gas reserves could degrade potential wilderness areas and could bring a "boom-and-bust" scenario to the local economies across the region. However, it is unlikely to play an important role in the region's future economic development. Mining income dropped from two percent of total personal income in 1969 to 0.5 percent in 1995 in Kane and Garfield Counties. Increases in efficiency from automation have resulted in downward employment trends in extractive industries throughout the West. In addition, a public subsidy would be required to overcome high start-up and transportation costs associated with the remote geographic location.

Agriculture—While farms in the study area tend to be small, public lands are used for grazing cattle and sheep. Grazing allotments within the Monument show that 98% of the Monument is allocated for grazing. Most of the proposed wilderness across the Monument is at risk of vegetation, soil and water quality degradation from grazing. While the large allocation of public land to grazing seems to suggest that ranching is still an important economic force in the region, employment and income data suggest a downward trend. Agricultural jobs in Garfield and Kane Counties have declined in relative importance from 37% of the total jobs in 1960 to 10% in 1996.

Recreation and Tourism—Eleven percent of the study area is occupied by national parks, 15 percent by national forests and 10 percent by the Monument. Each supplies a different set of recreational opportunities. Scattered across the landscape are public golf courses, ski areas, campgrounds, trailheads, boat launches, visitor centers and unique natural features such as sandstone arches. These recreation opportunities attract tourists; 40 to 60 percent of total employment in Kane and Garfield Counties is associated with travel and recreation.

Timber—While logging history data are not available in spatial format, a map of the locations of commercial forest types was generated from the Utah and Arizona Gap Programs' vegetation data. The distribution of these forests coincides with the distribution of the national forest lands (fig. 9). Timber harvest and management of these forests affect water quantity and quality downstream. Forests on the Aquarius, Paunsaugunt and Kaibab Plateaus form the headwaters for the principal drainages in the Monument. Timber harvest also affects the communities across the region; however, the relative importance of the timber industry is steadily declining, with timber-based income dropping from 19% to 6% of total personal income between 1969 and 1995 in Garfield County.

Government—Sixty-four percent of the land across the study area is in federal ownership. Management of the public estate generates government employment and export dollars for communities across the region. The government is a prominent employer. Within 60% of the census block groups, government accounts for more than 20% of all jobs. Government jobs also account for 16% of total personal income in Garfield and Kane Counties.

The Wildness Qualities of the Landscape

The landscape features contributing to wildness in table 1 are difficult to represent with GIS data. In each of the maps described below, we attempt to illustrate the intended concept, if not a true quantitative measure. One of the six measures of wildness, unaltered ecological processes, is not used here because no adequate GIS data were available.

Solitude—Human population density is used as a surrogate for solitude. The Monument lies in a broad area where census blocks groups average less than one person per square mile (fig. 10). With the exception of a handful of communities, the entire study area averages less than 10 people per square mile, but tourism is increasing the flow of nonresidents to the region. Visitation at the Escalante

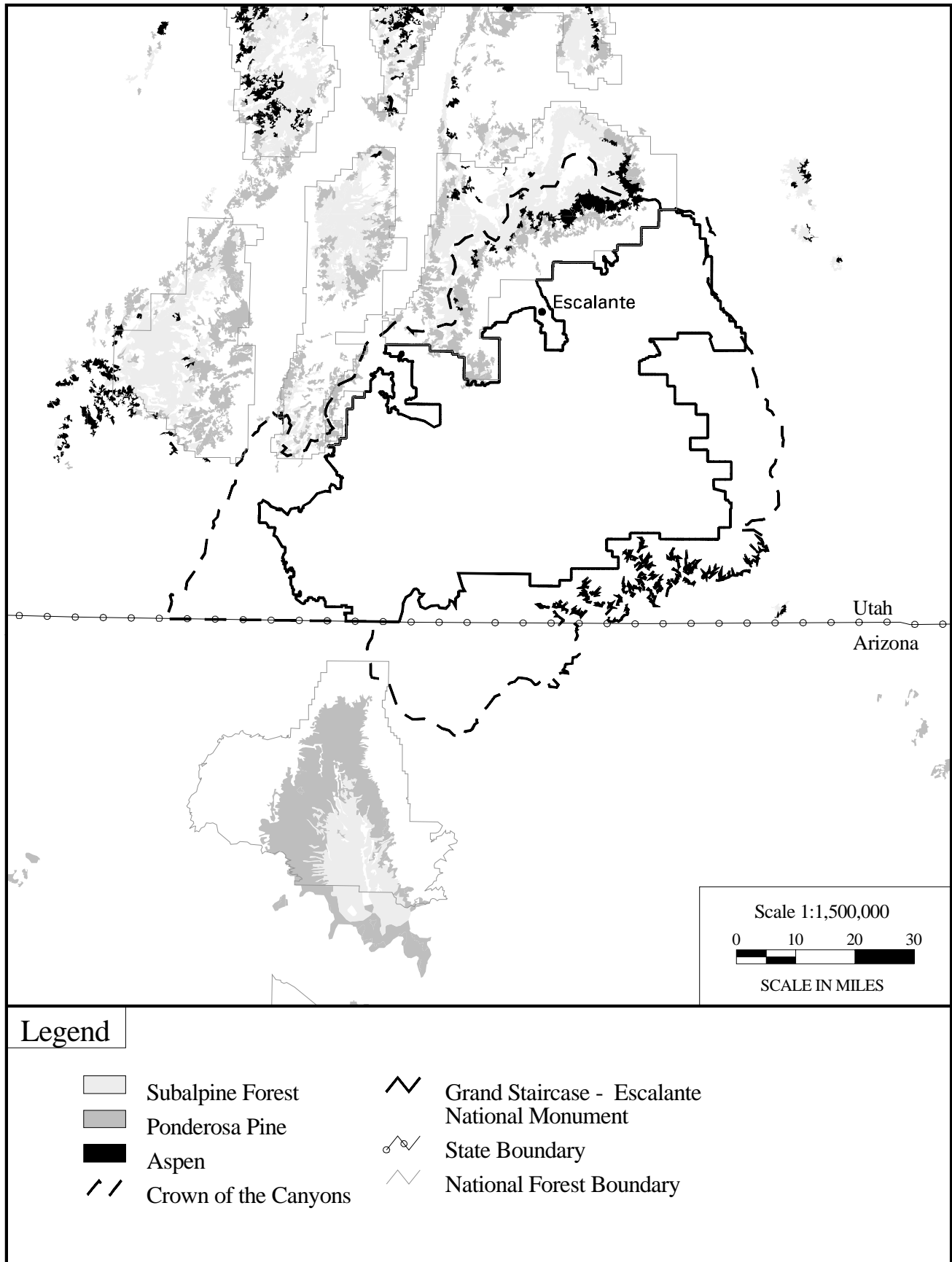


Figure 9—Socioeconomic landscape characteristic map: Commercial forest type. The forest products industry in the study area primarily harvests timber from the high-elevation plateaus outside of the Monument’s proposed wilderness areas.

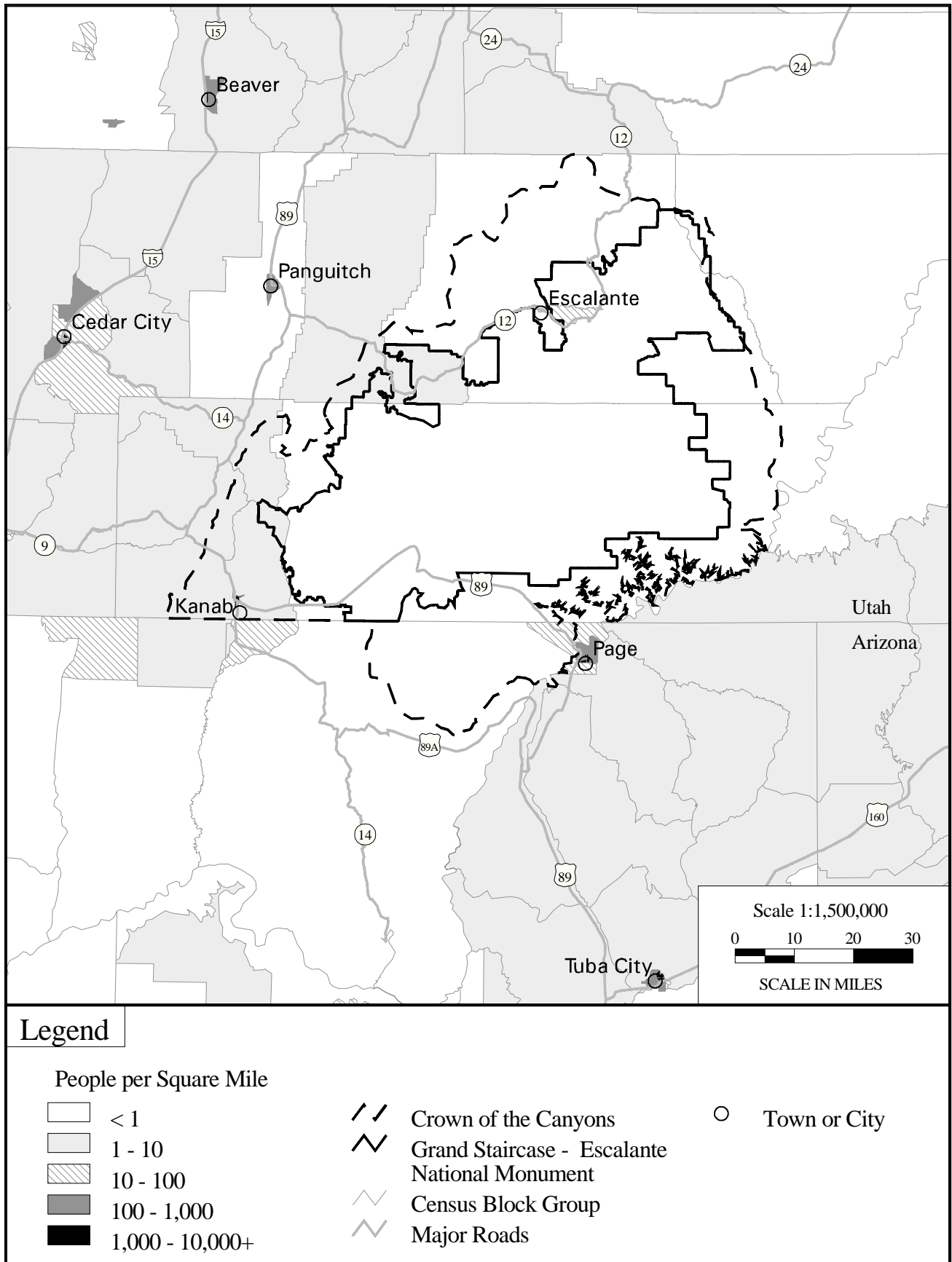


Figure 10—Wildness landscape characteristic map: Population density. The Crown of the Canyons area offers outstanding opportunities for solitude due to the low population density over most of the area.

Visitor Center increased from 5,000 in 1992 to over 25,000 in 1997. This landscape provides abundant opportunities for solitude within and beyond the proposed wilderness areas, but pressures on this aspect of a wilderness experience are growing.

Remoteness—Roads, ranging from major highways to well-maintained dirt roads, were used to show remoteness on the landscape. Much of the total study area is more than two kilometers (1.2 miles) from a road: 71% of the Utah portion of the study area, 84% of the Arizona portion and 80% of the Monument. While other minor but regularly used roads exist in the study area, opportunities for a remote wilderness experience abound.

Natural Composition—We illustrate natural composition with a map of lands that had been altered for urban and agricultural land use, location of natural springs and seeps and desert bighorn sheep habitat. While by no means a comprehensive description of natural composition, these elements demonstrate the natural character of the Monument and its ability to protect “scarce and scattered water resources” and habitat for bighorn sheep, elements that were specifically mentioned by the President in the proclamation establishing the Monument.

Unaltered Structure—Landsat Thematic Mapper satellite image data were used to show altered structure for three regions within the study area. Changes in the natural structure and pattern of vegetation are clearly visible in areas altered by private agricultural fields near Escalante, logging in the Dixie National Forest and chaining (the removal of pinyon-juniper forest for grazing) within the Monument. While these human alterations of the landscape are distinct at a coarse scale, other structural changes occur at a much finer scale, such as the trampling of cryptobiotic crusts by cattle, hikers and off road vehicles. Both are poorly inventoried across the study area.

Pollution—Pollution can take a multitude of forms, from road dust to bovine feces to herbicides. Some pollutants have a profound chemical effect on an ecosystem, and others primarily affect the human experience of wilderness. A map of EPA-regulated sites shows a low concentration of sites in this study area relative to much of the country. One hundred thirty-six sites in the area qualify for EPA monitoring and only one site within the Monument. A map of “City Lights at Night” from NASA shows light pollution from communities around the study area, but virtually none emanating from within the Monument.

Discussion

The results of our use of spatial data to represent the biophysical, socioeconomic and wilderness features showed us a variety of trends and relationships across the landscape. We chose to look closely for relationships that illustrate how the ecological integrity of proposed wilderness areas may be affected by elements outside their boundaries and how communities beyond the proposed wilderness areas are affected by elements in wilderness areas or the adjacent federal lands.

The Monument, most of which is proposed wilderness, shares borders with land managed by the National Park

Service, U.S.D.A Forest Service, BLM, state and private entities (fig. 3). It is also in close proximity to Native American tribal lands. Our biophysical landscape data support the idea that features or activities on these lands affect the ecological integrity of the proposed wilderness lands.

Relief and vegetation data suggest a potential dependence on adjacent lands for migration corridors. Major valleys of the Monument link low elevation Park Service lands along the Colorado River to high elevation Forest Service lands on the Aquarius Plateau. The Monument occupies the intermediate elevation and vegetation zones between these areas. It seems reasonable to expect that species use this gradient as a pathway between management units. Management practices across all of these lands should consider the needs of species that cross Monument boundaries.

Precipitation data show the Monument’s dependency on the adjacent Forest Service lands for its water supply. Precipitation is considerably greater in the higher plateaus of the Forest Service lands to the northwest. This area contains the headwaters of the Monument’s river systems. Activities that affect water quantity and quality in the headwaters will affect the Monument’s water supply. This relationship should be considered when the Forest Service makes decisions on land uses such as logging, road-building, off-road vehicle use and water development projects.

Disturbance data were difficult to represent in the landscape, but the fire regime data suggest that disturbances can cross administrative boundaries and affect the composition and structure of plant communities in the Monument. The data documenting altered structure in the landscape pointed to similar potential effects. Changing vegetative patterns through agriculture and logging adjacent to the Monument can affect ecological processes such as the flow of water or patterns of species movement into and out of the Monument. Land managers prescribing practices that alter natural disturbances or structures of the landscape should consider their impacts on the Monument.

Turning our attention to the communities of the sparsely populated study area, several towns are in close proximity to the Monument (fig. 2). Our results support the idea that these communities are affected by the landscape characteristics of the Monument and other surrounding federal lands.

Income data offer an indication of the relationship of wilderness and federal lands to local communities. The fact that nonlabor income in Kane and Garfield counties accounts for nearly 40% of total personal income, higher than in the state as a whole, suggests that people live here for reasons other than jobs. Individuals that are retired or have investment income choose to live in this area. This suggests that the natural amenities of the region play a role in drawing people to the region. The Monument and its surrounding federal lands define the environment for these towns and are the foundation for amenity-based community development.

Employment data also provide indicators of how the monument and other federal lands may affect local communities. The striking increase in service sector employment and its dominance over other sectors across much of the region indicates that the extractive industries are not the primary source for local employment. This trend is likely associated with increased recreation on the adjacent federal lands, suggesting a link between quality recreational

opportunities and the communities' employment base. The simple presence of so much federal land in the region is important because the management of these lands employ a significant proportion of the population. This is notable because, like nonlabor income and portions of the service sector employment, it brings in dollars from outside the region into the local economy.

The impact of recreation on local communities is more complicated than simply bringing tourist dollars to the local economy. The proposed wilderness lands of the Monument, the national parks, forest service lands and other natural attractions for recreation are spread across the region. The landscape's strong qualities of wildness (solitude, remoteness, natural composition, unaltered structure, and minimal pollution) draw people to the area for outdoor recreation. Maintaining the integrity of all of the public lands throughout the region will tend to increase the numbers of dollars and tourists flowing into these communities. It also places communities in the position of dealing with a set of issues including the increasing proportion of jobs in the service sector, the infrastructure needs of more people, urban development patterns, the influx of major chain businesses obscuring local business and the boom-and-bust cycles of tourism. Management of the federal lands and their recreational opportunities should be done in concert with local community planning.

Conclusions

The use of biophysical, socioeconomic and wildness spatial data proved useful for assessing the content and context of wilderness lands in and around the Grand Staircase-Escalante National Monument. Ecological data identified links between proposed wilderness lands in the Monument and adjacent land units. Socioeconomic data pointed to links between the local communities and the proposed wilderness and adjacent federal lands. This translates into two points of management coordination. First, to maintain the ecological integrity of the proposed wilderness areas they must be managed in a coordinated manner with adjacent federal, state and private lands. Second, the economic health of local communities depends on the condition and coordinated management of the federal public lands that encompass much of the landscape.

In the future, using spatial data to assess landscape characteristics should prove useful for wilderness managers working to provide sound stewardship in ecologically and culturally complex landscapes. Such information should also be useful for educating the public and other constituencies whose support is needed for implementation of sound management practices.

Future work is needed in two aspects of this project: improved data sources and data integration. Some of the landscape features, particularly the wildness features, need more meaningful spatial data sets developed to represent them. Fortunately, sources of GIS data are increasing in quantity, quality and accessibility.

The results of this project were generated from basic GIS processes. A more sophisticated comparison and integration of multiple landscape features across wilderness boundaries could highlight the concentrations and distributions of

important landscape features. This would facilitate their application by wilderness managers and their use in communicating results of wilderness context studies to diverse audiences.

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