

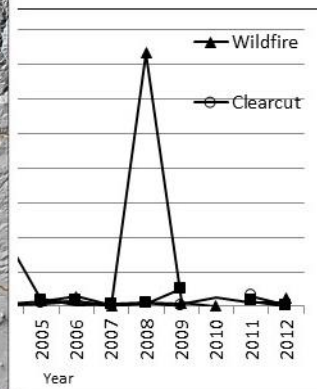
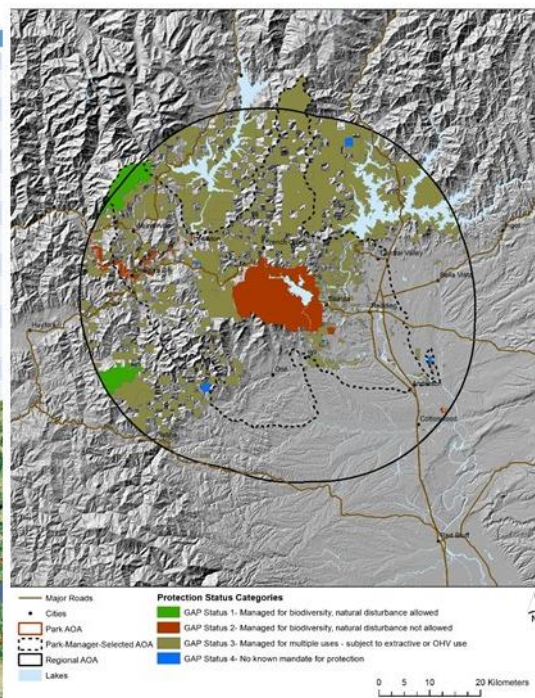
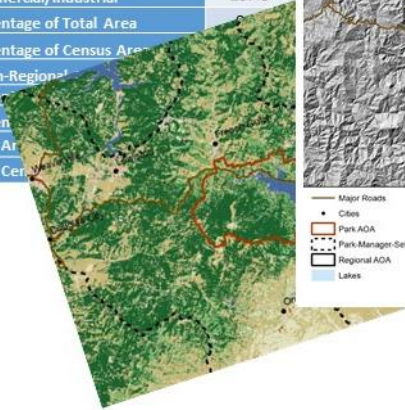


Land Cover and Land Use Monitoring

2016 Results for Whiskeytown National Recreation Area

Natural Resource Data Series NPS/KLMN/NRDS—2017/1096

Regional Housing Density Classes	
Rural (<6 units/ km ²)	2502.77
Percentage of Total Area	54.56
Percentage of Census Area	88.57
Exurban (7–146 units/ km ²)	273.97
Percentage of Total Area	5.97
Percentage of Census Area	9.70
Suburban (146–1235 units/ km ²)	19.11
Percentage of Total Area	0.42
Percentage of Census Area	0.68
Urban (>1235 units/ km ²)	0.41
Percentage of Total Area	0.01
Percentage of Census Area	0.01
Commercial/Industrial	29.49
Percentage of Total Area	
Percentage of Census Area	
Urban-Regional	
Percentage of Total Area	
Percentage of Census Area	
Total Area	
Total Census Area	



ON THE COVER

Samples of maps and statistics shown in this report: 2012 Protected Area Gap Status, 2011 Land Cover, LANDFIRE Disturbance Graph, and Housing Density table.

Land Cover and Land Use Monitoring

2016 Results for Whiskeytown National Recreation Area

Natural Resource Data Series NPS/KLMN/NRDS—2017/1096

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on well-established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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Executive Summary

This report summarizes landscape conditions in Whiskeytown National Recreation Area in California. Landscape spatial structure resulting from natural processes, and its variation through time, underlies the diversity and integrity of ecosystems. Composition (types and amounts of different land cover), configuration (spatial arrangement of land cover types), and connectivity determine habitat availability, the movements of organisms, and energy and material flow on a landscape. In 2016, the Klamath Network, in partnership with Southern Oregon University, completed and implemented our land cover and land use monitoring protocol (Mohren et al. 2016a). The goal of this monitoring effort is to support National Park Service (NPS) management of natural resources by providing relevant landscape-scale information about ecosystem composition and structure and land use to each of the NPS units in the Klamath Network.

The Klamath Network protocol uses methods associated with the NPS NPScene project, which provides information on the status and trends of park natural resources at ecosystem-level and regional scales. We used Geographic Information System (GIS) tools to analyze largely regional- and national-level datasets at three spatial scales for the following landscape indicators: Conservation Status, Land Cover, Landscape Pattern, Housing and Population, Roads, and Disturbance. The three spatial scales are the park boundary (Park), watersheds adjacent to the park boundary (Park-Manager-Selected), and a 30 km buffer around the park boundary (Regional). The number of years available for each dataset varies and is therefore not consistent across all landscape metrics. For some metrics, we present results for multiple years but do not analyze for or discuss change over time; trend analysis will be the subject of future reports.

To improve flow and readability of the report, data tables are included in the appendix.

Conservation Status

Public land around the Whiskeytown National Recreation Area (hereafter, Whiskeytown) was primarily owned by the US Forest Service and Bureau of Land Management. Little of this area was permanently protected from conversion to an unnatural state. About a third of the area had a moderate level of conservation protection that still allows broad, low intensity or localized, high intensity extractive uses. Data were not available for a large portion of the area.

Land Cover

In the areas surrounding the park, the most abundant cover type was evergreen forest, followed by shrub/scrub, and herbaceous vegetation. The park itself was also dominated by evergreen forest with some shrub/scrub, mixed forest, and deciduous forest but there was little herbaceous cover. Most cover was categorized as natural, with converted areas primarily in cities and towns. The total amount of impervious surface (e.g., asphalt) was minimal in and around the park.

Landscape Pattern

Landscape cover was mostly forest, followed by shrubland, and then grassland. While some forest patches were large and intact, many were thin sections that connected patches, resulting in much of the forest being on the edge of non-forest types. There were some large patches of grassland to the

south and southeast of the park. However, much of the grassland was small patches or thin sections connecting larger patches. Largest patches of intact shrubland were southwest of the park, and similar to grassland, much of the area was small patches or thin sections connecting larger patches. In all cover types, the most abundant patch size was small; however, within forest cover, most of the land area was in larger size patches.

Housing and Population

Whiskeytown was surrounded by housing developments categorized as “rural,” for their low density. The relative proportion of rural housing decreased between 1970 and 2010, coinciding with an increase in exurban, or medium density, housing. Population growth also increased outside the park between 1990 and 2010.

Roads

Outside the park, road densities were the highest along the I5 corridor, particularly in and around Redding. Areas within Whiskeytown-Shasta-Trinity National Recreation Area, Shasta-Trinity National Forest, and private lands were furthest from any roads. The largest sections of land without roads were in the southern part of Whiskeytown and extended south through private lands as well as within the Shasta-Trinity National Forest. There was little change in roads between 2010 and 2015.

Disturbance

Wildfire was the dominant disturbance between 1999 and 2012 in and around the park. In areas outside the park, tree harvesting also occurred.

Acknowledgments

Many people supported this project. The NPScape team developed much of the material. We would especially like to thank Bill Monahan, Lisa Nelson, and Michelle Kinseth.

We are immensely grateful to the NPS Resource Managers, Biologists, Ecologists, and GIS Specialists who contributed to this protocol throughout its development, with special thanks going to Sean Denniston (CRLA), Jennifer Gibson (WHIS), and Russ Weatherbee (WHIS). Monika Tantare, a Southern Oregon University student, did extensive practical work using ArcGIS tools to make maps and calculate statistics.

The data used to develop the summaries in these reports came from a variety of sources, without which this project would not be possible. We especially want to thank the staff at the US Census Bureau, the USGS Land Cover Institute, and the GAP Analysis Program.

List of Abbreviations

Abbreviation	Description
AOA	Area of Analysis
BLM	Bureau of Land Management
DOI	US Department of Interior
GAP	Gap Analysis Program
GIS	Geographic Information System
HUC	Hydrologic Unit Code
I&M	Inventory and Monitoring
IRMA	Integrated Resource Management Applications
NLCD	National Land Cover Data (or Database, Dataset)
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PAD-US	Protected Areas Database of the United States
SERGoM	Spatially Explicit Regional Growth Model
SOP	Standard Operating Procedure
USGS	United States Geological Survey

Introduction

The purpose of natural resource monitoring in national park units is to develop scientifically sound information about the current status and long-term trends in the composition, structure, and function of park ecosystems. Managers can use monitoring information to increase confidence in their decisions and improve their ability to manage park resources. This increased knowledge will allow managers to confront and mitigate threats to the parks and operate more effectively in legal and political arenas (Stephens et al. 2010).

The Klamath Inventory and Monitoring Network (KLMN) vital signs selection process identified important questions to answer in relation to potential trends in ecosystem structure, function, and composition in the parks. Using the process described in the *Vital Signs Monitoring Plan for the Klamath Network: Phase II Report* (Odion et al. 2005), land cover and land use ranked ninth out of the ten vital signs that were selected. The land cover/land use vital sign was selected in an effort to address the following objectives:

1. Determine the status and trends in the composition and configuration of land cover classes within all the Klamath Network parks and directly adjacent land.
2. Determine the status and trends in the connectivity of the land cover classifications.
3. Determine the status and trends in human populations near the parks.
4. Determine trends in disturbances.

The goal of this monitoring effort is to support National Park Service's (NPS) management of natural resources by providing relevant landscape-scale information to each of the NPS units that make up the Klamath Network. The composition (types and amounts of different land cover), configuration (spatial arrangement of land cover types), and connectivity of land cover determine habitat availability, the movements of organisms, and energy and material flows on a landscape (Turner et al. 2001).

This report follows methods and guidance in the *Land Cover and Land Use Monitoring Protocol for the Klamath Network* (Mohren et al. 2016a). We summarize the purpose and methods of the protocol in this report; complete details are in the protocol (<https://irma.nps.gov/DataStore/Reference/Profile/2237050>).

We monitor land cover/land use in the Whiskeytown National Recreation Area (hereafter, Whiskeytown). The overall objective of this report is to determine for Whiskeytown the status of the metrics described in the KLMN land cover/land use monitoring protocol: Conservation Status, Land Cover, Landscape Pattern, Housing and Population, Roads, and Disturbance. Trend measurements and modeling will be addressed in future reports, as stated in the protocol.

Whiskeytown is located at the southeastern edge of the Klamath Mountains in northern California. It is located in Shasta County, at the northern end of the Sacramento Valley, 137 km (85 miles) inland from the Pacific Ocean, and 13 km (8 miles) west of the city of Redding, California. While there are

US Forest Service and Bureau of Land Management lands in close proximity to the park, much of the park's 74 km (46 mile) boundary borders private land.

Whiskeytown encompasses shrubland, oak woodland, and conifer forest that surround the 1,416 hectare (3,500 acre) Whiskeytown Lake. Elevations in the park range from 244 meters (800 feet) at the southern end of lower Clear Creek, to 1,893 meters (6,209 feet) at the summit of Shasta Bally. Whiskeytown's location within the Klamath Mountain physiographic province and proximity to the Cascade Mountains, Coast Range Mountains, and Sacramento Valley provides for a diversity of habitats. A broad range in elevation, rugged topography, numerous soil types, and a history of natural and anthropogenic disturbance also contribute to its landscape heterogeneity. At low elevations, summers are hot and dry, and winters are cool with occasionally heavy rainfall. Temperature readings over 37.8 °C (100 °F) occur often during the months of May through October, with occasional subfreezing temperatures from November through March.

The enabling legislation of Congress established Whiskeytown on November 8, 1965, under Public Law 89-336, and identified specific responsibilities. The park was to "provide...for the public outdoor use and enjoyment" of the specified reservoirs and surrounding lands "by present and future generations, and for the conservation of scenic, scientific, historic, and other values contributing to public enjoyment of such lands and water." The conservation of resources takes priority over recreation, and all resource management activities must be consistent with this dual mission.

Anthropogenic disturbances associated with mining, logging, and suppression of wildland fire or efforts to suppress fire have had the most powerful impact on the health and sustainability of Whiskeytown's plant and animal communities (Odion et al. 2005).

Methods

The Klamath Network is using data and tools from the NPScape project, which was designed to provide information on the status and trends of park natural resources at broad regional and ecosystem scales. Details on the NPScape project can be found at <http://science.nature.nps.gov/im/monitor/npscape/>. This report is a snapshot in time based on the project's available data and tools.

The Inventory and Monitoring Central Office is currently developing a national landscape dynamics protocol with a target completion date of 2017. After implementation of the national protocol, the NPScape program will stop supporting the toolboxes that were used to conduct the analyses in this report. Alternatively, the national program will continue calculating the same metrics in this report as part of the national landscape dynamics protocol, provided through the NPS Statistics Summary database, and visualized via the Landscape Dynamics Metric Viewer (<https://nps.maps.arcgis.com/apps/webappviewer/index.html?id=2ec2585fa978404fbe316ec280645518>).

Areas of Analysis

The choice of spatial scales for a landscape-level analysis has a significant impact on natural resource metrics and anthropogenic influences. The scale of analysis should be considered thoughtfully as no single scale or set of scales can meet all needs (Gross and Svancara 2009). For this protocol, we identified three spatial scales based on park needs and recommendations from the scientific literature. These three spatial scales, which we call Areas of Analysis (AOAs), include 1) Park, 2) Park-Manager-Selected, and 3) Regional (Figure 1).

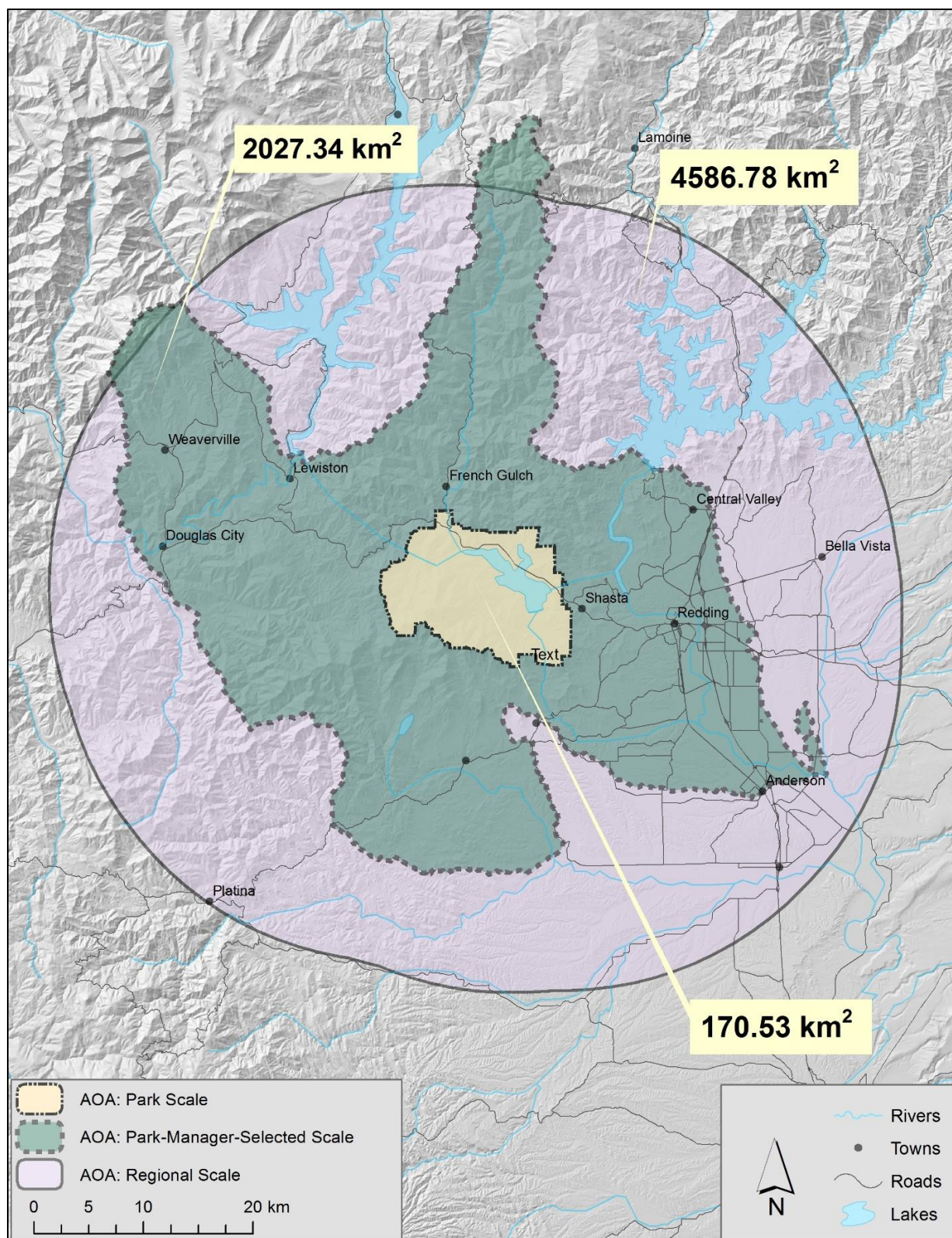


Figure 1. Reference map of all three Whiskeytown National Recreation Area Areas of Analysis (AOA).

Park Scale

The Park AOA uses the park boundary (Nelson and Kinseth 2016). This AOA encompasses the area that NPS park managers have the most influence over and can directly alter through management actions. Analysis at this scale will give park managers the best possible picture of changes that are occurring in the park.

Park-Manager-Selected Scale

Because natural resources, ecological processes, and anthropogenic influences cross jurisdictional boundaries, the “Park-Manager-Selected” AOA includes the park and lands adjacent to the park. Specifically, this AOA is at the watershed level. The US Geological Survey (USGS) assigns watersheds a Hydrologic Unit Code (HUC) of 10 (<https://water.usgs.gov/GIS/huc.html>) and we follow the HUC10 boundaries of watersheds that are fully or partially inside the park. For Whiskeytown, the Park-Manager-Selected AOA covers 2027 km² and comprises the following watersheds: Churn Creek-Sacramento River, Clear Creek, North Fork Cottonwood Creek, and Weaver Creek-Trinity River.

Regional Scale

The third AOA addresses landscape metrics at a regional level. The effective domain of many local ecological processes is thought to be on the order of 15 to 40 km, but few studies have demonstrated effects at distances greater than 25 km. Therefore, our Regional AOA includes the park and all adjacent areas within 30 km of the park boundary.

Data Sources

This protocol uses data developed by other entities as a cost-effective approach to landscape monitoring. An additional benefit of using regional- and national-level data is the ability to use the same datasets and maintain consistency across the different areas of analysis. In Table 1, we list our data sources. Additional details on these data sources can be found in the protocol.

Table 1. Data sources for Whiskeytown land cover/land use results.

Dataset	Year	Indicator
Protected Areas Database of the United States (PAD-US)	2012	Conservation Status
National Land Cover Data (NLCD)	2006 and 2011	Land Cover and Pattern
US Census Bureau Block Group data	1970-2010	Housing and Population
US Census Bureau roads data (TIGER) and Whiskeytown NRA road data	2010 and 2016	Roads
USGS Landscape Fire and Resource Management Planning Tools (LANDFIRE)	1999-2012	Disturbance

Timeframe

Different years are reported for different landscape variables, depending on dataset availability. We present results for multiple years for some landscape variables, but this is not intended to show change over time. Future reports will examine trends.

Indicator Analysis

This section briefly describes the GIS analyses used for landscape indicators in this report. Detailed information on each indicator can be found in the standard operating procedures associated with the land cover and land use monitoring protocol for the network (Mohren et al. 2016b). Not all indicators are relevant to all AOAs; thus Table 2 outlines which indicators are reported for each.

We did not perform any statistical analyses in this report. Any mention of change among years is purely descriptive and does not imply trend.

Table 2. Indicators that will be evaluated in the listed Areas of Analyses (AOA) at Whiskeytown: P = Park, PM = Park-Manager-Selected, and R = Regional.

Indicator	Measure	AOA Scale
Conservation Status	Percentage & Total Protected	PM & R
	Percentage & Total Ownership	PM & R
Land Cover	Area/Percentage in Land Cover Types	P, PM, & R
	Natural vs. Converted	P, PM, & R
	Impervious Surface	P, PM, & R
Landscape Pattern	Morphological Pattern Analysis	PM & R
	Patch Size by Cover Type	PM & R
	Distribution of Patch Sizes for Cover Types	PM & R
	Density Analysis of Cover Types	PM & R
Housing and Population	Housing Density	PM & R
	Recent Change in Housing Density	PM & R
	Total Population	PM & R
	Population Density	PM & R
	Recent Population Change	PM & R
Roads	Road Density	P, PM, & R
	Road Length	P, PM, & R
	Distance to Roads	P, PM, & R
	Area without Roads	P, PM, & R
Disturbance	Disturbance Occurrence	P, PM, & R
	Total Area by Disturbance Type	P, PM, & R

Landscape Dynamics Indicators

The NPScape program used ArcToolbox and Python scripting to create utilities in ESRI ArcGIS that run automatically. We used these utilities to analyze the seven indicators below.

Conservation Status and Ownership

We analyzed data from the Protected Areas Database of the United States (PAD-US) to summarize ownership and conservation status. The PAD-US is produced by the USGS Gap Analysis Program (GAP), the primary developer of land stewardship and protected areas information in the United States. Ownership and conservation status is unknown for areas that are categorized in PAD-US version 1.3 as “unavailable data.” *SOP #2 (Conservation Status Metrics)* of the land cover/land use protocol for the network provides detailed methods for this indicator.

Within the Regional and Park-Manager-Selected AOAs, we used the ownership and status categories (Table 3) to summarize the percentage of area and total area that were considered protected, as well as the percentage of area and total area by ownership.

Table 3. Protection status categories from the Protected Areas Database of the United States, produced by the USGS Gap Analysis Program.

Status	Description
1	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
2	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
3	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area, as is required by law.
4	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Land Cover

We analyzed land cover for the three AOAs using National Land Cover Data (NLCD). We calculated the proportion of the landscape at each Level 2 class (Table 4) within each AOA using data from 2006 and 2011. NLCD classes are modified from the Anderson land use and land cover classification system (Anderson et al. 1976). In addition, we calculated the total area for each land cover type. Also, using 2011 data, we calculated impervious surface cover and summarized total area and percentage of area within surface class categories. In this analysis, each pixel value denotes how much of that pixel has an impervious surface. Natural lands vs. converted lands (Table 4) were also

summarized by total area and percentage of area, and the percentage change in area, using data from 2011. Detailed methods for this indicator are provided in the protocol (*SOP #3: Land Cover Metrics*).

Table 4. National Land Cover Data (NLCD) land cover classes, modified from the Anderson land use and land cover classification system.

Level 1	Level 2	Natural/Converted
1 Open Water	11 Open Water	Natural
	12 Perennial Ice/Snow	Natural
2 Developed	21 Developed Open Space	Converted
	22 Developed Low Intensity	Converted
	23 Developed Medium Intensity	Converted
	24 Developed High Intensity	Converted
3 Barren/Quarries/Transitional	31 Barren Land	Natural
4 Forest	41 Deciduous Forest	Natural
	42 Evergreen Forest	Natural
	43 Mixed Forest	Natural
5 Shrub/Scrub	51 Dwarf Scrub	Natural
	52 Shrub/Scrub	Natural
7 Grassland/Herbaceous	71 Grassland/Herbaceous	Natural
	72 Sedge/Herbaceous	Natural
	73 Lichens	Natural
	74 Moss	Natural
8 Agriculture	81 Pasture/Hay	Converted
	82 Cultivated Agriculture	Converted
9 Wetlands	90 Woody Wetlands	Natural
	95 Emergent Herbaceous Wetlands	Natural

Landscape Pattern

These analyses were performed for the Park-Manager-Selected and Regional AOAs. Morphology data were generated from 2011 NLCD for forest, grassland, and shrubland. We used morphology data with an edge width of 5 (EW5), which is 5 pixels at 30 m resolution. Density data were also generated with a 7×7 pixel window size (size in m^2 and acres: $210 m^2$, 10.9 acres).

We examined both the morphology and density of three Level 1 classes (Table 4): Forest, Shrubland, and Grassland. As with Landscape Cover metrics, NLCD classes are modified from the Anderson land use and land cover classification system. The morphology of each land cover type was classified

into morphological pattern types (e.g., edge, core, bridge), as defined in Table 5 and Figure 2. Descriptions in Table 5 are provided by the USDA Forest Service (<https://forestthreats.org/research/tools/landcover-maps/mspa>). We provided a summary of total area and percentage of area for each pattern type. We also provided the count and total area of patches in different size classes.

Table 5. Pattern types describing area morphology for National Land Cover Data cover. Simplified descriptions were provided by the US Forest Service's Morphological Spatial Pattern Analysis (MSPA) of forest cover map.

Pattern Type	Technical Definition	Description
Branch	A cluster of non-core pixels connected to one edge.	Connected at one end to edge, perforation, bridge, or loop
Edge	Pixels within a defined distance ('edge') to the background. We used an edge of 150 m (5 pixels).	Outside perimeter
Islet	Island of pixels that is not core habitat.	Disconnected and too small to contain core
Core	Pixels that are within a patch, and more than 10 m from non-patch types. In other words, core areas are areas that are not near the transition zones of classification types.	Interior area of patch excluding perimeter
Bridge	A cluster of non-core pixels connected at two or more locations to edge.	Connected at both ends to different core patches
Perforated	Inner boundary of a core area that is adjacent to a hole in the core area.	Inside perimeter
Loop	A cluster of pixels that connects to two or more locations of the same edge	Connected at both ends to the same core patch

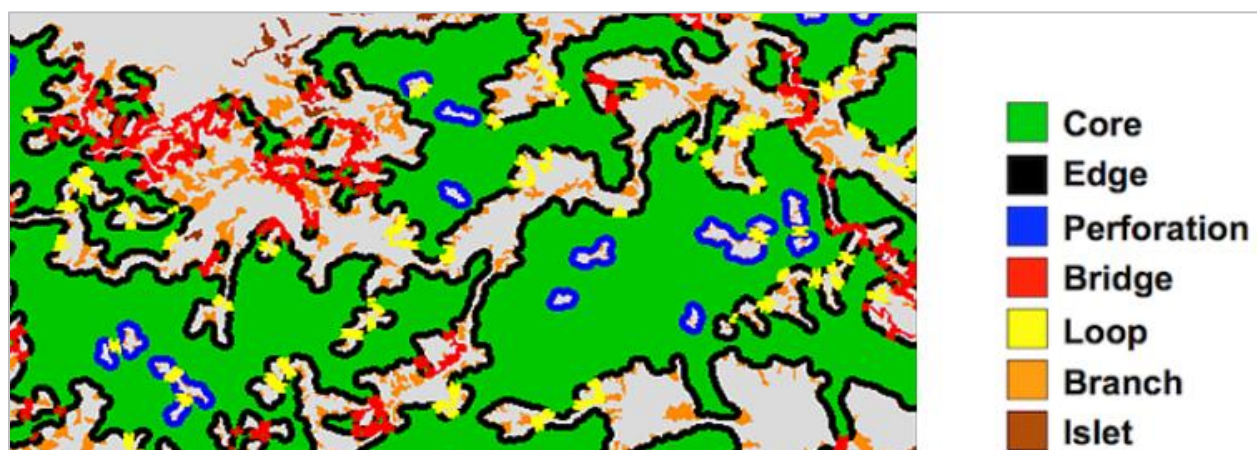


Figure 2. Illustration of morphological pattern types on a landscape. Image provided by Peter Vogt of the European Commission Joint Research Centre.

The density of each class is summarized in seven categories (Riitters 2011) and shown in Table 6. A land cover type is considered highly dense if no other land cover type or open space is detected in its vicinity. For forest, grassland, and shrubland cover types, we calculated the total and relative area in each density class observed, as well as the percent of each density class in the AOA. Detailed methods for this indicator are provided in the protocol (*SOP #04: Pattern Metrics*).

Table 6. Area density class definitions for forest, grassland, and shrubland cover within a moving window GIS analysis (window size can vary depending on pixel size and image detail). These classes follow Riitters (2011). As a window moves across the landscape, the density is the percentage of pixels of a cover type in the window calculated for the pixel at the center of the window. Higher values of p (area density) mean a higher percentage of forest, grassland, or shrubland cover in a set area. For example, in the forest cover type, higher density means that the area surrounding the pixel is also mostly forested.

Area Density Class	Area Density (p)
Intact	$p = 1.0$
Interior	$0.9 \leq p < 1.0$
Dominant	$0.6 \leq p < 0.9$
Transitional	$0.4 \leq p < 0.6$
Patchy	$0.1 \leq p < 0.4$
Rare	$0.0 \leq p < 0.1$
None	$p = 0.0$

Housing and Population

Detailed methods for this indicator are provided in the protocol (*SOP #5: Housing Metrics* and *SOP #6: Population Metrics*).

Housing density metrics use the Spatially Explicit Regional Growth Model (SERGoM v3) (Theobald 2005), which is based on US Census Bureau source data. To simplify reporting, we grouped housing densities into density classes (Table 7). We summarized data by these grouped classes for Park-Manager-Selected and Regional AOAs using data from 1970 to 2010. By class, we provided total area, percentage of total AOA, and percentage of census area (area where the census occurred, generally omitting the park, national forests, etc.).

Population metrics are also based on US Census Bureau data. Census Block-Groups can cover large areas and may include areas with higher population; however, the Block-Groups are smaller than counties and better display population data near rural or protected areas. We used all the Census Block-Groups that intersect the AOAs and resulting blocks were clipped to AOAs. Areas where people are assumed to be absent were subtracted or masked out; this included water (from Census water data) and PAD-US protected areas (status 1 and 2—areas that maintained primarily in a natural state). Note that this does exclude the six in holdings that exist within the park boundary. At the Park-Manager-Selected and Regional AOAs, we provided summaries for the total population and population density as well as changes in population size and density for 1990, 2000, and 2010 data.

Table 7. Grouped housing density classes represent one or more housing density classes. Data are from the US Census Bureau.

Grouped Housing Density Class	Housing Density Class
Urban-Regional Park	Urban-Regional Park
Commercial / Industrial	Commercial / Industrial
Urban	>2,470 units / km ²
	1,235–2,470 units / km ²
Suburban	495–1,234 units / km ²
	146–495 units / km ²
Exurban	50–145 units / km ²
	25–49 units / km ²
	13–24 units / km ²
	7–12 units / km ²
Rural	4–6 units / km ²
	1.5–3 units / km ²
	< 1.5 units / km ²
	Private undeveloped

Roads

Detailed methods for this indicator are provided in the protocol (*SOP #7: Road Metrics*). We completed this analysis for Park-Manager-Selected and Regional AOAs with 2010 and 2015 TIGER data using the four road codes described in Table 8: primary road; secondary road; local neighborhood road, rural road, city street; vehicular trail (4WD). TIGER data may not always represent current conditions. For example, TIGER data may not immediately reflect when a road is decommissioned and used as a trail instead. Nonetheless, TIGER provides a consistent data source across time and space.

We summarized total road length and road density. Additionally, we provided the same summaries within the Park AOA using 2016 data from the park.

Additionally, we looked at the distance to the nearest road (each pixel was assigned the value of how far it was from the nearest road). This could be used to compare areas that are virtually roadless to areas where road densities have the ability to affect ecological integrity. Finally, we counted roadless areas and summarized their total area within size categories. Water bodies (using the USGS National Hydrography Dataset 2015, <https://nhd.usgs.gov/data.html>) were erased and then polygons smaller than 0.0144 km² were removed.

Table 8. US Census Bureau TIGER road codes used in this report.

Code	Type	Description
S1100	Primary Road	Primary roads are generally divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.
S1200	Secondary Road	Secondary roads are main arteries, usually in the U.S. Highway, State Highway or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. They often have both a local name and a route number.
S1400	Local Neighborhood Road, Rural Road, City Street	Generally a paved non-arterial street, road, or byway that usually has a single lane of traffic in each direction. Roads in this feature class may be privately or publicly maintained. Scenic park roads would be included in this feature class, as would (depending on the region of the country) some unpaved roads.
S1500	Vehicular Trail (4WD)	An unpaved dirt trail where a four-wheel drive vehicle is required. These vehicular trails are found almost exclusively in very rural areas. Minor, unpaved roads usable by ordinary cars and trucks belong in the S1400 category.

Disturbance

Detailed methods for this indicator are provided in the protocol (*SOP #8: Disturbance Metrics*). We used the USGS Landscape Fire and Resource Management Planning Tools (LANDFIRE) data for 1999 to 2012. LANDFIRE includes disturbance data (e.g., harvest, development) in addition to fire data. For all three AOAs, we provided total area and percentage of AOA by disturbance types, defined in Table 9.

Table 9. USGS Landscape Fire and Resource Management Planning Tools (LANDFIRE) disturbance categories.

Category	Description
Development	Conversion of natural lands into housing, commercial, or industrial building sites. Involves permanent land clearing.
Clearcut	The cutting of essentially all trees, producing a fully exposed microclimate for the development of a new age class.
Harvest	A general term for the cutting, felling, and gathering of forest timber. The term harvest was assigned to events where there was not enough information available to call them one of the 2 distinct types, clearcut or thinning.
Thinning	A tree removal practice that reduces tree density and competition between trees in a stand. Thinning concentrates growth on fewer, high-quality trees, provides periodic income, and generally enhances tree vigor.
Mastication	Means by which vegetation is mechanically “mowed” or “chipped” into small pieces and changed from a vertical to horizontal arrangement.
Other Mechanical	Catch-all term for a variety of forest and rangeland mechanical activities related to fuels reduction and site preparation including: piling of fuels, chaining, lop and scatter, thinning of fuels, Dixie harrow, etc.

Table 9 (continued). USGS Landscape Fire and Resource Management Planning Tools (LANDFIRE) disturbance categories.

Category	Description
Wildfire	An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to suppress or put out the fire.
Wildland Fire Use	The application of the appropriate management response to naturally-ignited wildland fires to accomplish specific resource management objectives in pre-defined designated areas outlined in Fire Management Plans.
Prescribed Fire	Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements (where applicable) must be met, prior to ignition.
Wildland Fire	A catch-all term used to describe any non-structure fire that occurs in the wildland. Three distinct types of wildland fire have been defined: wildfire, wildland fire use, and prescribed fire. The term wildland fire was assigned to events where there was not enough information available to call them one of the 3 distinct types.
Insects	Infestations of unwanted insects that can affect vegetative health such as bark beetle.
Disease	Infestations of disease that can affect vegetative health such as root rot.
Biological	The use of living organisms, such as predators, parasites, and pathogens, to control weeds, pest insects, or diseases.

Results

Results are presented using text, maps, and figures in the following sections. Tables containing the detailed values associated with these results are referenced here with an “A” prefix, but presented in full in Appendix A to avoid lengthy diversion from the text.

As a reminder, results for each of the three levels of spatial analysis include the area of the park at each level’s core. Also, different years are reported for different landscape variables, depending on dataset availability. We did not perform any statistical analyses in this report. Any mention of change among years is purely descriptive and does not imply trend.

Conservation Status

Ownership

In 2012, most of the land for which data were available within the Regional AOA was owned by the US Forest Service (20.7%), followed by the Bureau of Land Management (10.3%). Within the Park-Manager-Selected AOA, 9.9% of the land was US Forest Service and 18.7% was Bureau of Land Management (Figures 3 and 4; Table A1 in Appendix A, *Data Tables*). Note that data for 64.3% of the Regional AOA and 61.4% of the Park-Manager-Selected AOA were not available and therefore the percentage of land managed by each of these groups may have been greater, depending on the composition of the unavailable data.

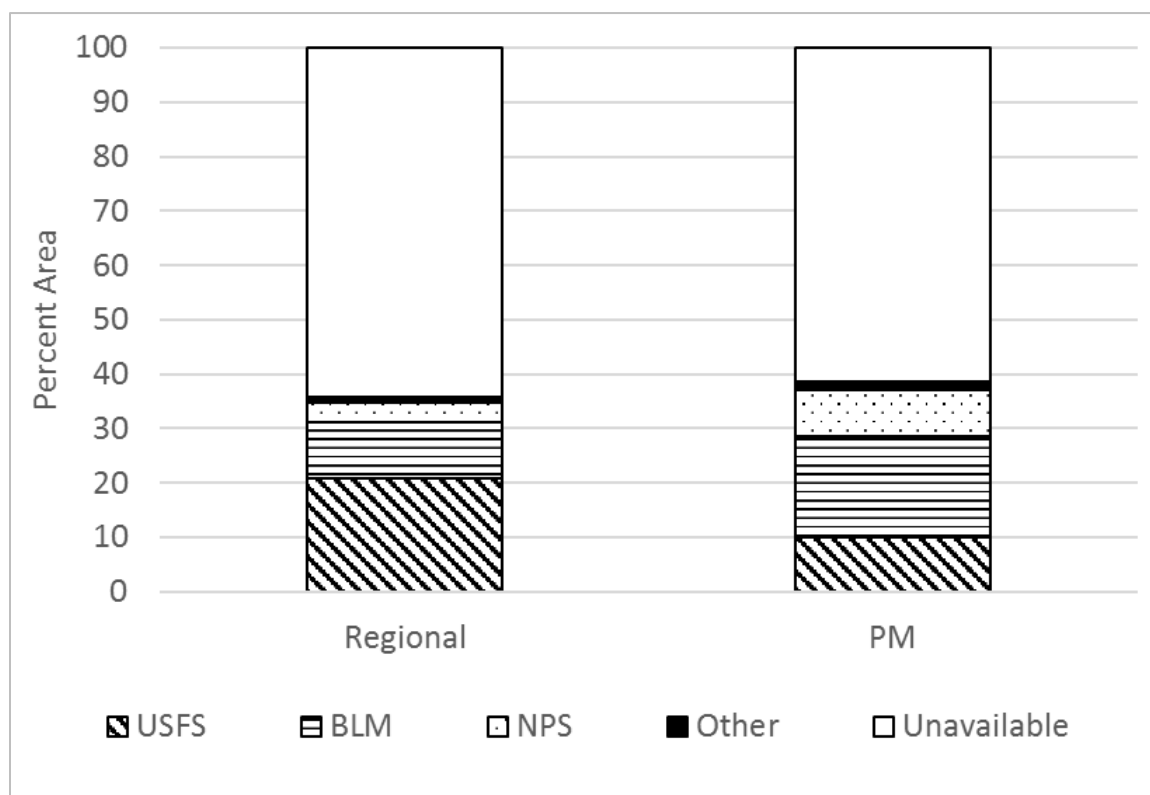
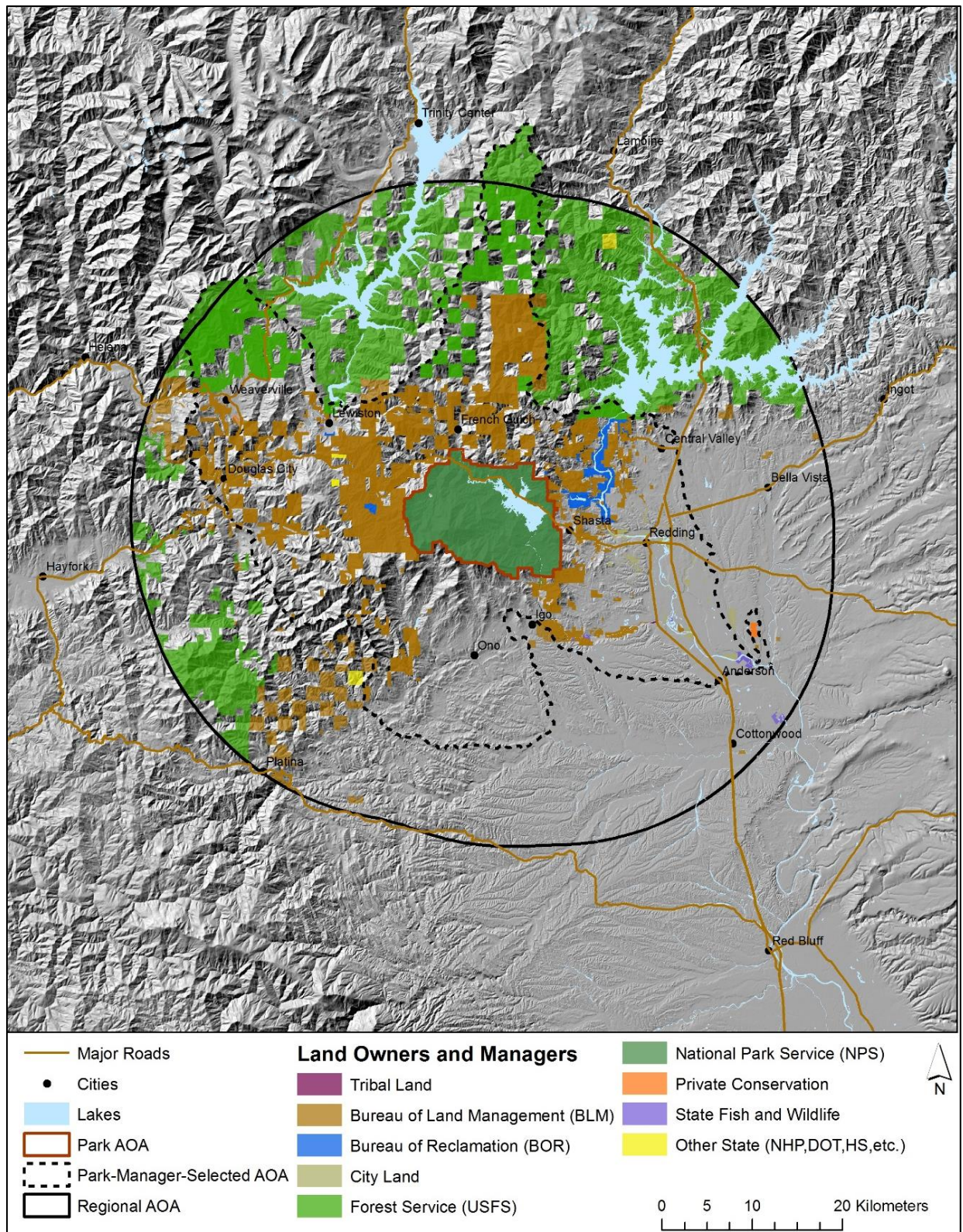


Figure 3. Percentage of land ownership within the Regional and Park-Manager-Selected (PM) Areas of Analysis (AOA) in 2012.



Protected Areas

The USGS Gap Analysis Program (GAP) Conservation Status 1 is the most protected status, representing permanent protection from conversion of natural land cover and a mandated management plan (see Methods, Table 3, for status definitions). Within the Regional and Park-Manager-Selected AOAs, this category is represented primarily by US Forest Service wilderness areas. In 2012, Status 1 constituted 1.3% and 1.9% of the Regional and Park-Manager-Selected AOAs, respectively (Figures 5 and 6; Table A2). Within the Regional and Park-Manager-Selected AOAs, the largest single category of land was in Status 3 (29.9% and 27.3%, respectively). These areas have permanent protection from conversion of natural land cover for the majority of the area, but are subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). Federally listed endangered and threatened species are also protected throughout the area. Data for 64.3% of the Regional AOA and 61.4% of the Park-Manager-Selected AOA were not available; therefore, the percentage of land managed within each status category may have been greater, depending on the composition of the unavailable data.

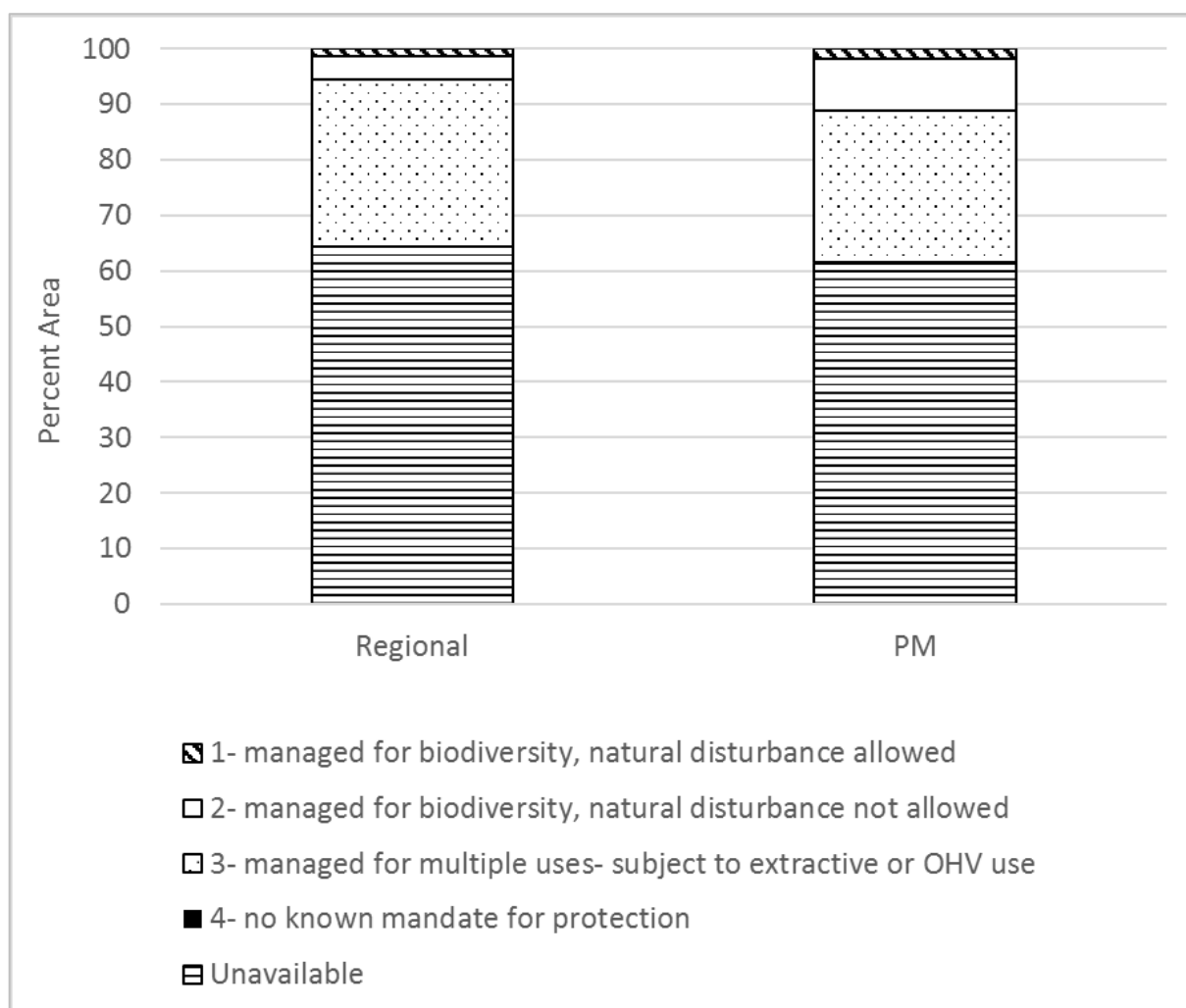


Figure 5. Percentage in each USGS Gap Analysis Program (GAP) Conservation Status category within the Regional and Park-Manager-Selected (PM) Areas of Analysis (AOA) in 2012.

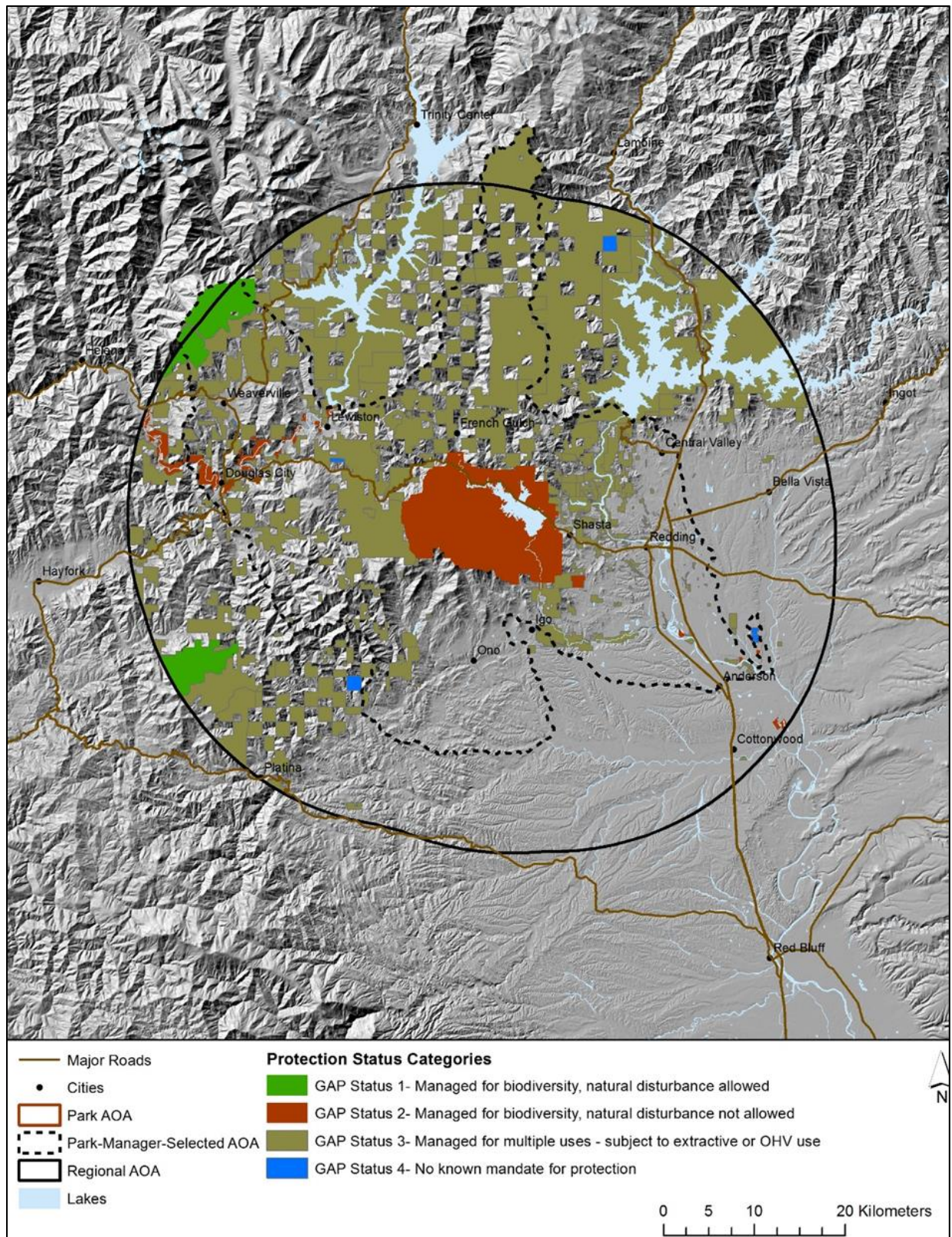


Figure 6. Protection status category in the Regional and Park-Manager-Selected Areas of Analysis (AOA), using 2012 data from the USGS Gap Analysis Program (GAP) Protected Areas Database for the US (PAD-US).

Land Cover

Land Cover Classes

We summarized land cover using the National Land Cover Data (NLCD) Level 2 classes (see Methods, Table 4, for class definitions). *Evergreen Forest* was the most abundant cover type in both 2006 and 2011, and in all three AOAs. *Shrub/Scrub* was the next most abundant cover type (Figures 7, 8, and 9).

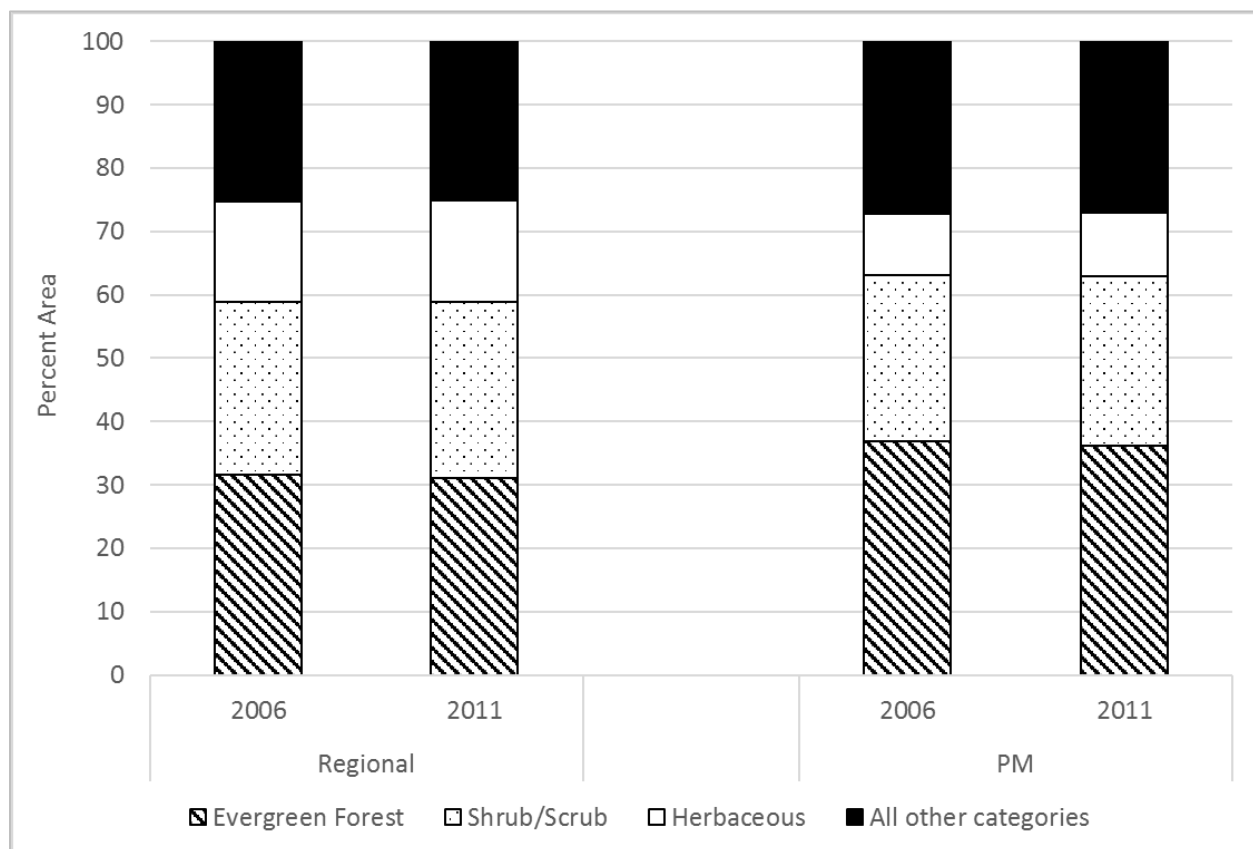


Figure 7. Percentage of National Land Cover Data Level 2 classes in Regional and Park-Manager-Selected (PM) Areas of Analysis (AOA) for 2006 and 2011.

In the Regional AOA, *Evergreen Forest* comprised 31.6% (2006) and 31.1% (2011) of the land cover, *Shrub/Scrub* comprised 27.3% (2006) to 27.8% (2011) of the land cover, and *Herbaceous* comprised 15.7% (2006) and 16.1% (2011) of the land cover (Table A3). Other classes each covered less than 6% of the AOA.

Similarly, in the Park-Manager-Selected AOA, *Evergreen Forest* was 36.9% (2006) and 36.1% (2011) of the land cover, *Shrub/Scrub* was 26.3% (2006) and 26.8% (2011) of the land cover, and *Herbaceous* was 9.6% (2006) and 10.1% (2011) of the land cover (Table A4).

In the Park AOA, *Evergreen Forest* represented 52.4% (2006) and 51.5% (2011) of the land cover, and *Shrub/Scrub* represented 14.0% (2006) and 14.9% (2011) of the land cover (Figure 9). Unlike

the larger AOAs, the Park AOA had very little *Herbaceous* cover and had relatively more area in *Mixed Forest* (10.5% in 2006 and 10.4% in 2011), *Deciduous Forest* (10.8% in 2006 and 10.6% in 2011), and *Open Water* (6.9% in 2006 and 7.18% in 2011) (Table A5).

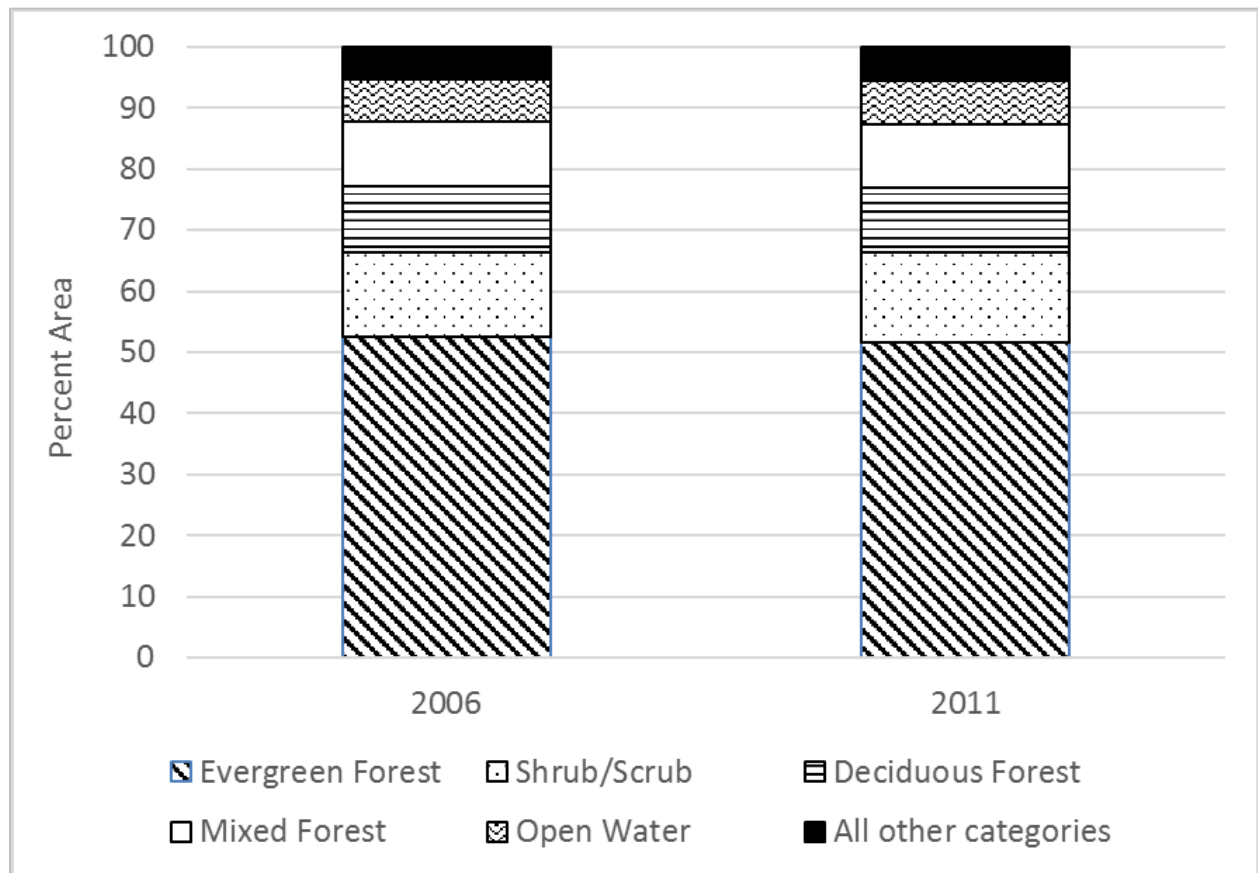


Figure 8. Percentage of National Land Cover Data Level 2 classes in the Park Area of Analysis (AOA) for 2006 and 2011.

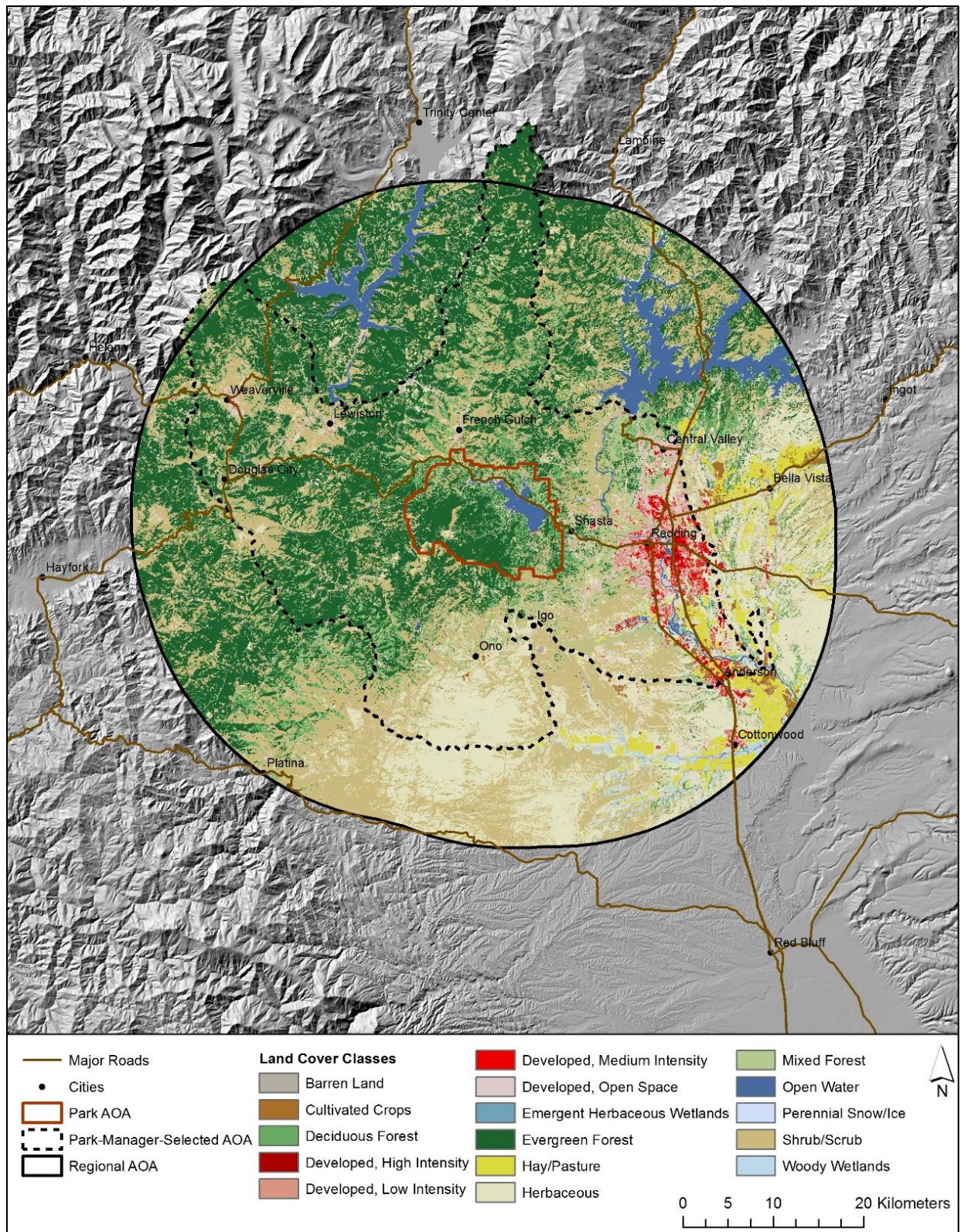


Figure 9. Land cover by National Land Cover Data Level 2 classes at Regional, Park-Manager-Selected, and Park Areas of Analysis (AOA) in 2011.

Impervious Surface Cover

In 2006 and 2011, the majority of each AOA lacked impervious surface (i.e., 0%–2% impervious surface class) (Figure 10; Tables A6–A8). This lowest impervious surface class occurred in greater than 95% of the Regional AOA, greater than 92% of the Park-Manager-Selected AOA, and greater than 97% of the Park AOA. Likewise, less than 2% of the area had a high amount of impervious surface (50%–100% impervious surface class).

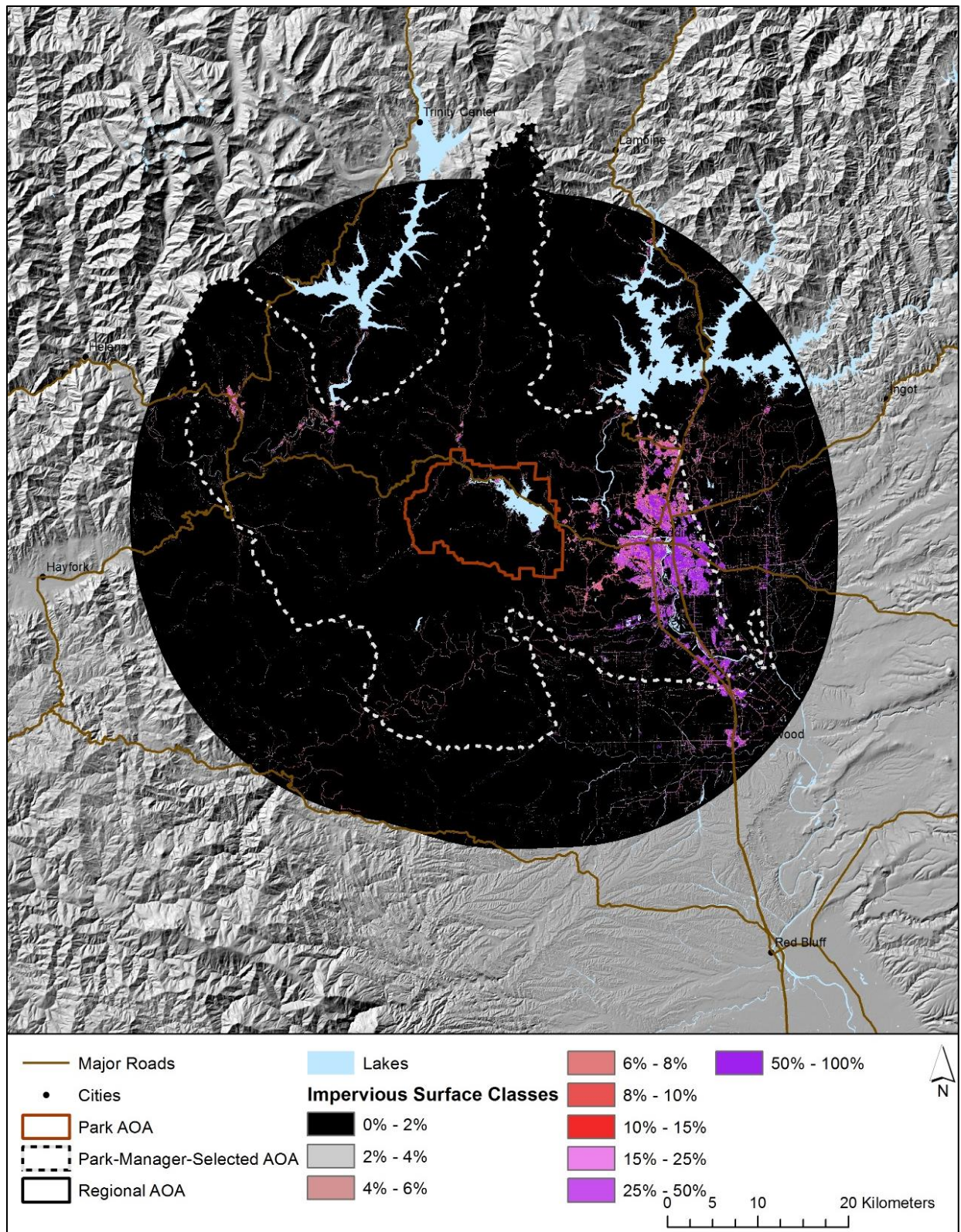


Figure 10. Impervious surface area at Regional, Park-Manager-Selected, and Park Areas of Analysis (AOA) in 2011.

Natural vs. Converted

For all three AOAs, the majority of the land cover was categorized as *Natural* in 2006 and 2011 (see Methods, Table 4, for cover classes). *Natural* land cover in both 2006 and 2011 comprised 90.4% of the Regional AOA, 89.6% of the Park-Manager-Selected AOA, and 95.9% of the Park AOA (Figure 11; Tables A9–A11). At all three AOAs, little change in area (km²) has occurred since 2006. Most of the *Converted* areas were cities and towns, especially those along the Interstate 5 corridor and around Weaverville. Outside of towns, *Converted* areas throughout the AOAs are roads.

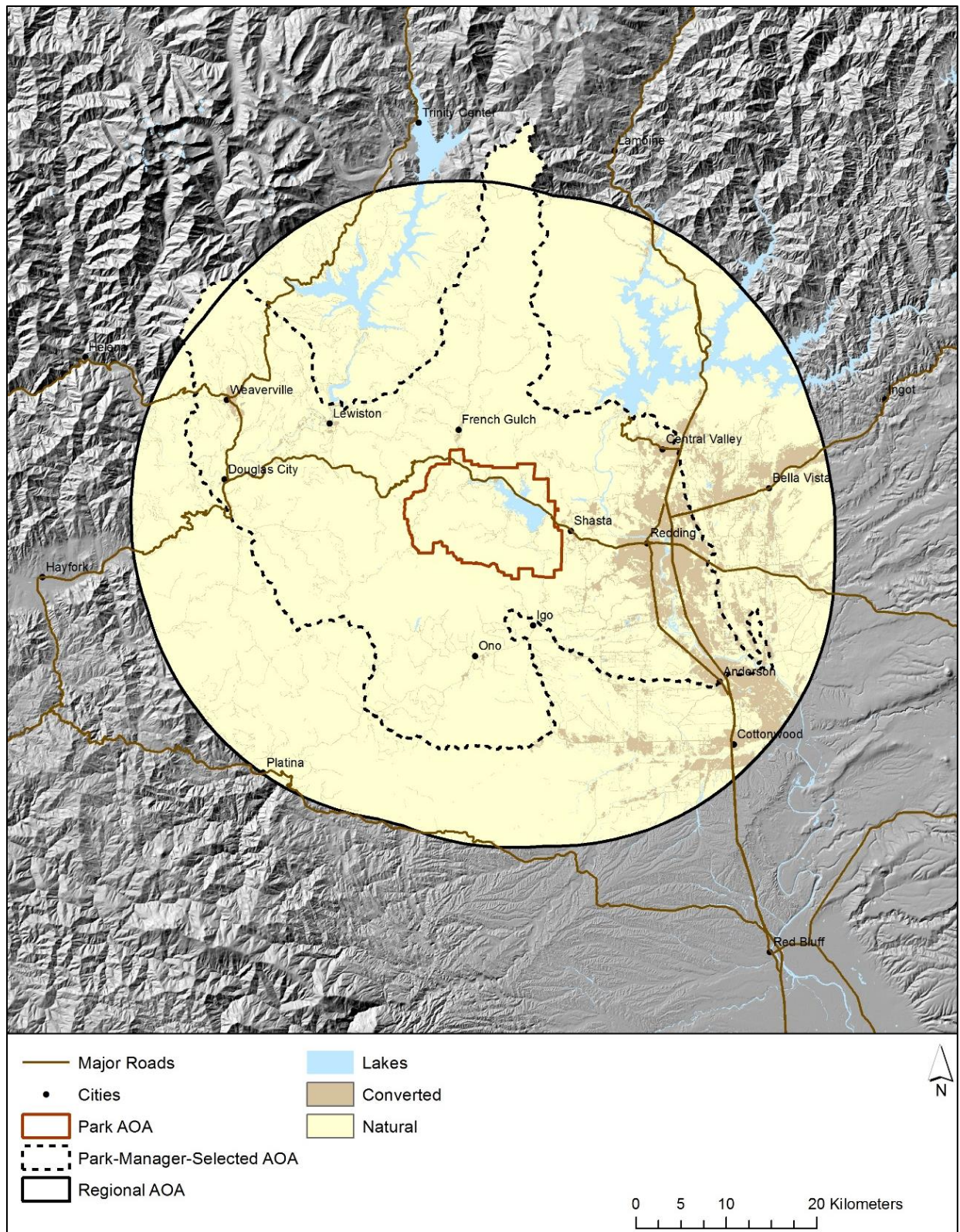


Figure 11. Natural and converted lands at Regional, Park-Manager-Selected, and Park Areas of Analysis (AOA) in 2011.

Landscape Pattern

Morphology

Forest

Forest covered the greatest portion of the landscape in 2011, primarily in the northwestern half of the park. In the Regional AOA, 42.6% was forested (Figure 12). Forest was categorized as *Bridge* (37.6%) and *Edge* (29.5%), followed by *Core* (15.1%) (Table A12) (see Methods, Table 5, for pattern definitions). There was a similar pattern in the Park-Manager-Selected AOA. Forest covered 51.1% of the area and was characterized as *Bridge* (34.8%) and *Edge* (31.8%), followed by *Core* (18.2%) (Table A12).

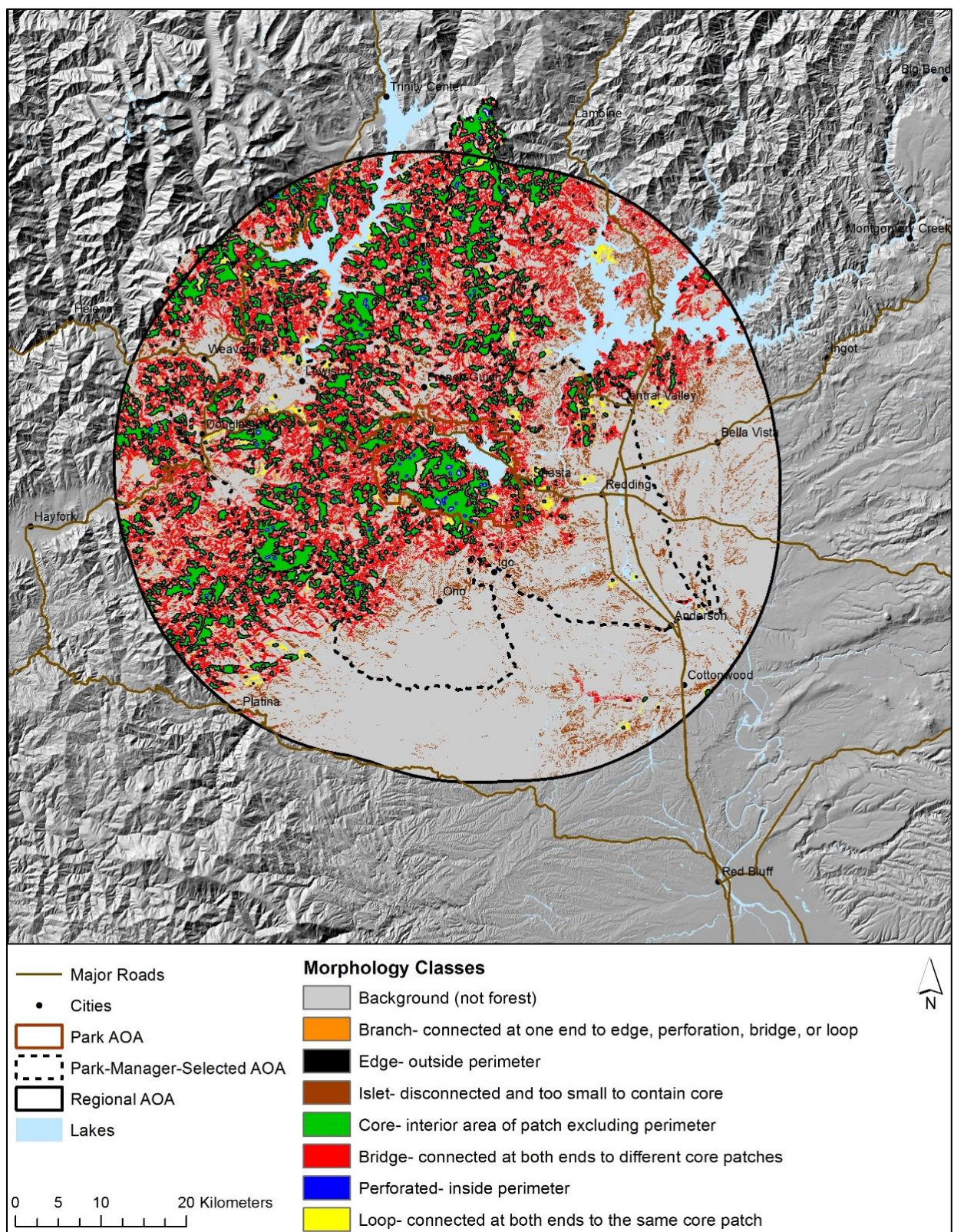


Figure 12. National Land Cover Data forest morphology classification for the Regional and Park-Manager-Selection Areas of Analysis (AOA) in 2011. Terms used in the legend were taken from the US Forest Service (<https://forestthreats.org/research/tools/landcover-maps/mspa>).

Grassland

In 2011, grassland occurred in approximately 19% of the Regional AOA and approximately 11% of the Park-Manager-Selected AOA (Table A13).

In the Regional AOA, grassland was categorized primarily as *Bridge* (34.8%), followed by *Islet* (23.8%) and *Edge* (20.6%) (see Methods, Table 5, for pattern definitions). In the Park-Manager-Selected AOA, grassland was categorized primarily as *Islet* (39.6%) followed by *Bridge* (19.8%) (Figure 13).

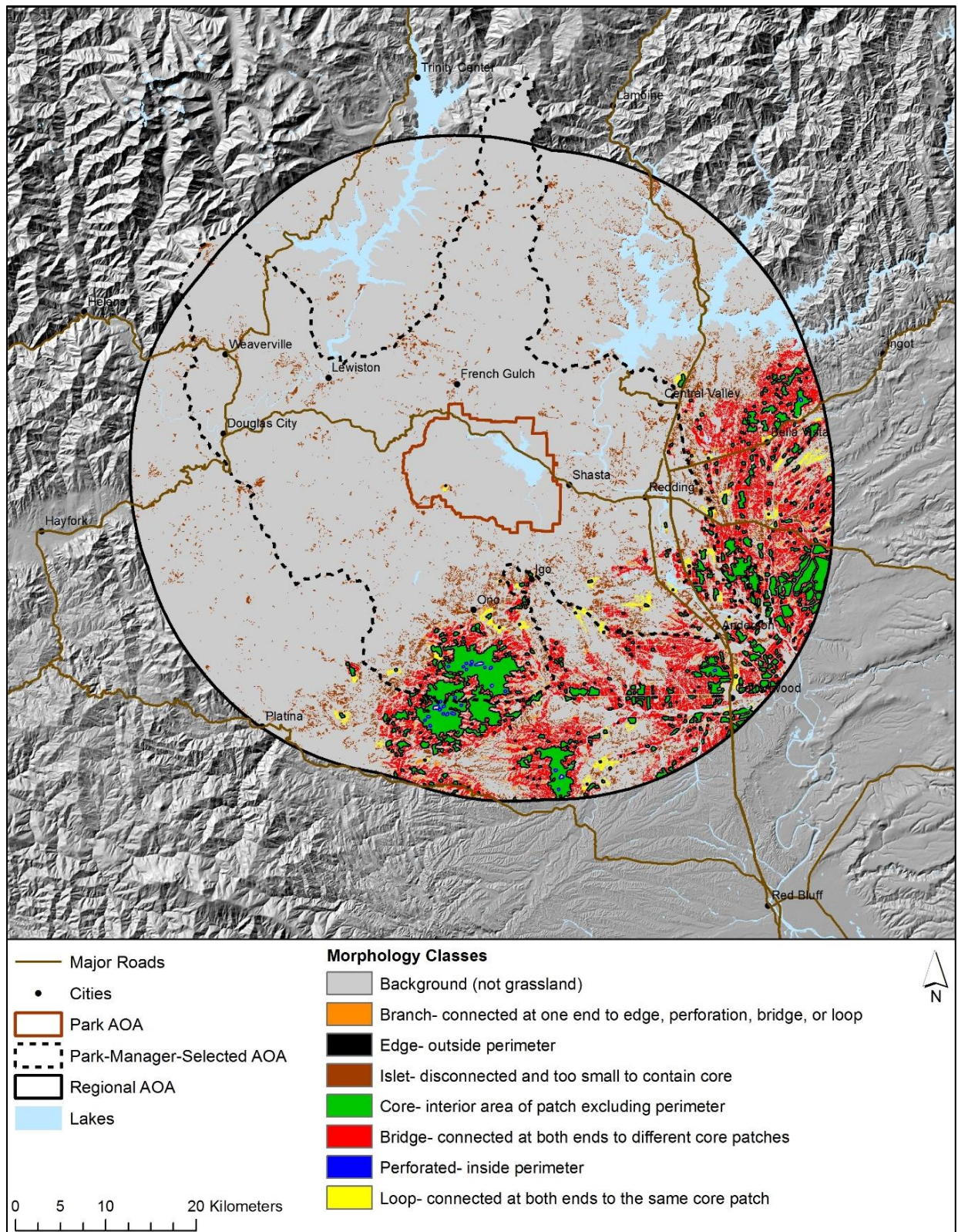


Figure 13. National Land Cover Data grassland morphology classification for the Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2011. Terms used in the legend were taken from the US Forest Service (<https://forestthreats.org/research/tools/landcover-maps/mspa>).

Shrubland

Shrubland comprised 27.8% of the Regional AOA, and 26.8% of the Park-Manager-Selected AOA. In the Regional AOA, shrubland was categorized primarily as *Islets* (43.1%), followed by *Bridge* (31.9%) (see Methods, Table 5, for pattern definitions). In the Park-Manager-Selected AOA, shrubland was categorized primarily as *Islet* (46.5%) followed by *Bridge* (30.7%) (Figure 14; Table A14).

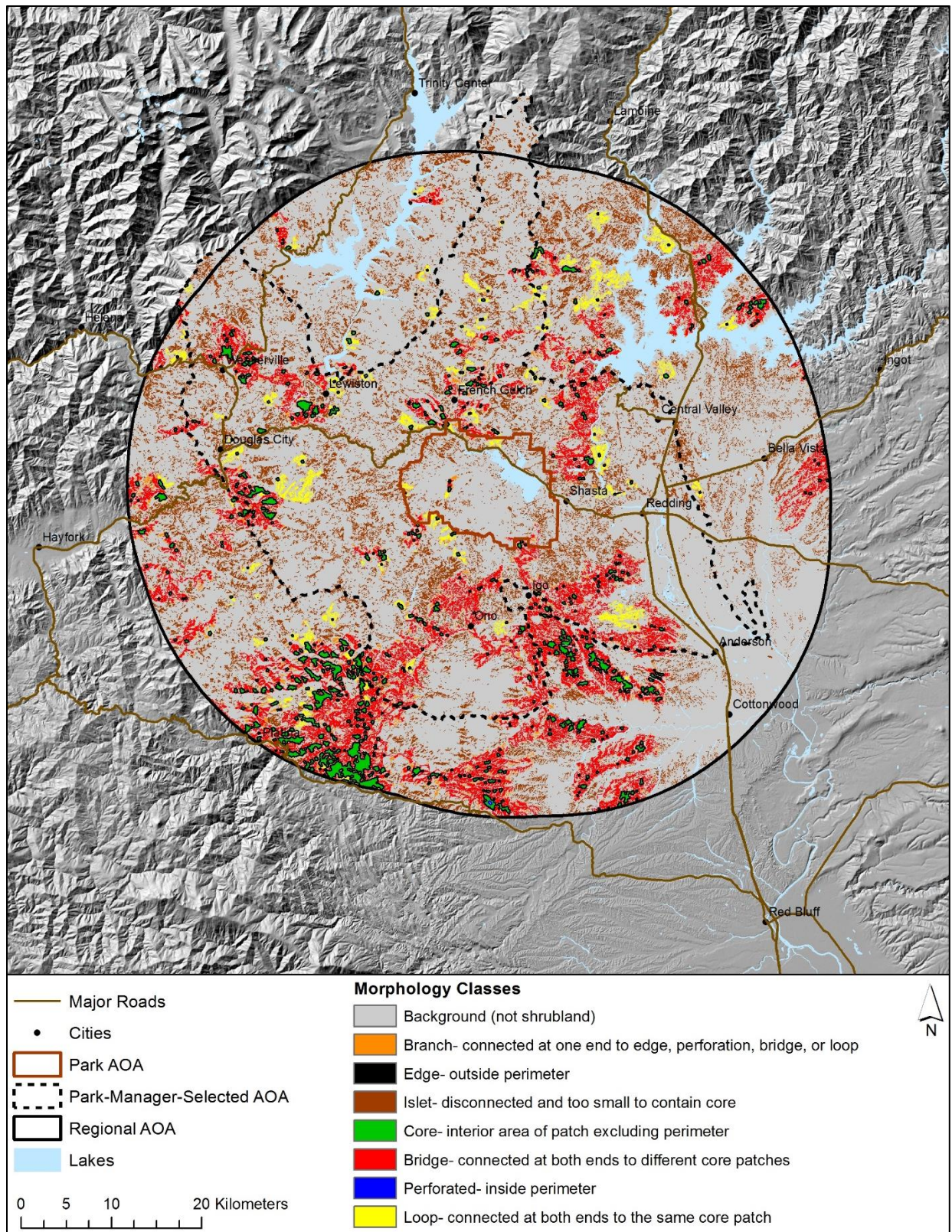


Figure 14. National Land Cover Data shrubland morphology classification for the Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2011. Terms used in the legend were taken from the US Forest Service (<https://forestthreats.org/research/tools/landcover-maps/mspa>).

Patch Size

Forest Patch Size

The majority of forest patches were less than 1 km², but the total combined area of these small patches was low in 2011. For the Regional AOA, most area was in the 500–1000 km² patch size category (Figure 15; Table A15). In the Park-Manager-Selected AOA, 3288 of 3311 patches were <1 km², but the total area of all patches was more evenly spread across the different categories.

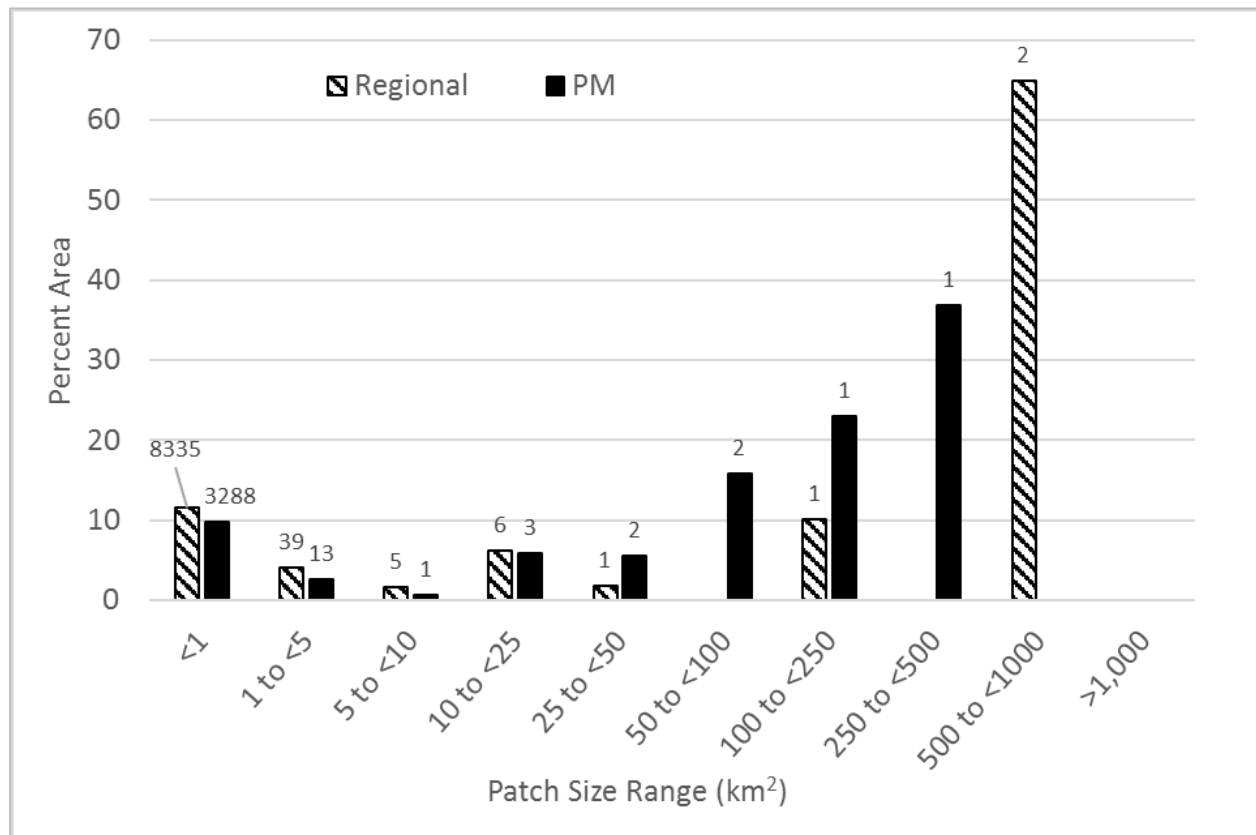


Figure 15. Percentage of area within each patch size category for forestlands in the Regional and Park-Manager-Selected (PM) Areas of Analysis (AOA) in 2011. The number at the top of each bar is the number of patches comprising the area.

Grassland Patch Size

In the Regional AOA in 2011, most patches were <1 km², although the total area in this small size class was similar to areas in other patch categories. In the Park-Manager-Selected AOA, most patches were also <1 km² and this category also had the most area (Figure 16; Table A16).

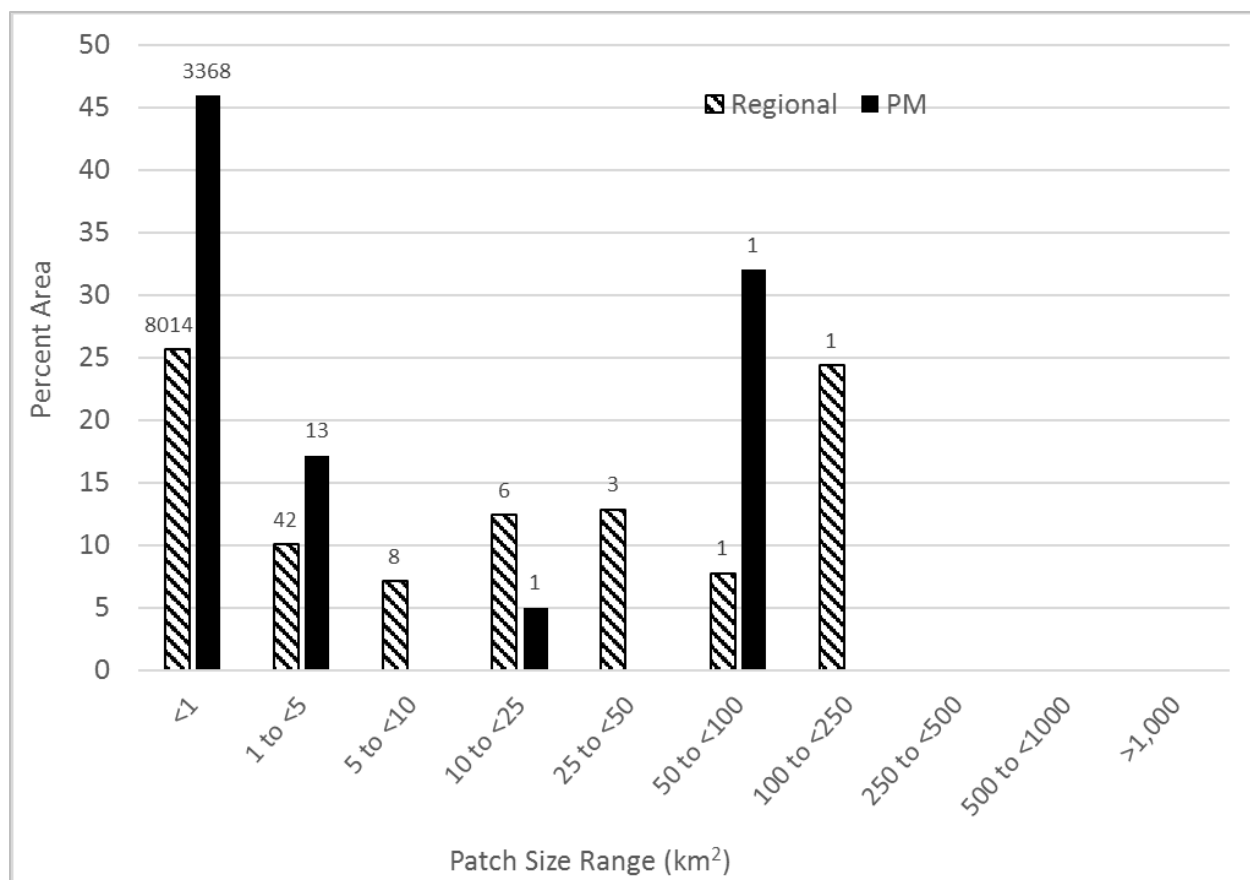


Figure 16. Percentage area within each patch size category for grasslands in the Regional and Park-Manager-Selected (PM) Areas of Analysis in 2011. The number at the top of each bar is the number of patches comprising the area.

Shrubland Patch Size

In the Regional and Park-Manager-Selected AOA, most patches were within the <1 km² range and these categories also had the most area (Figure 17; Table A17).

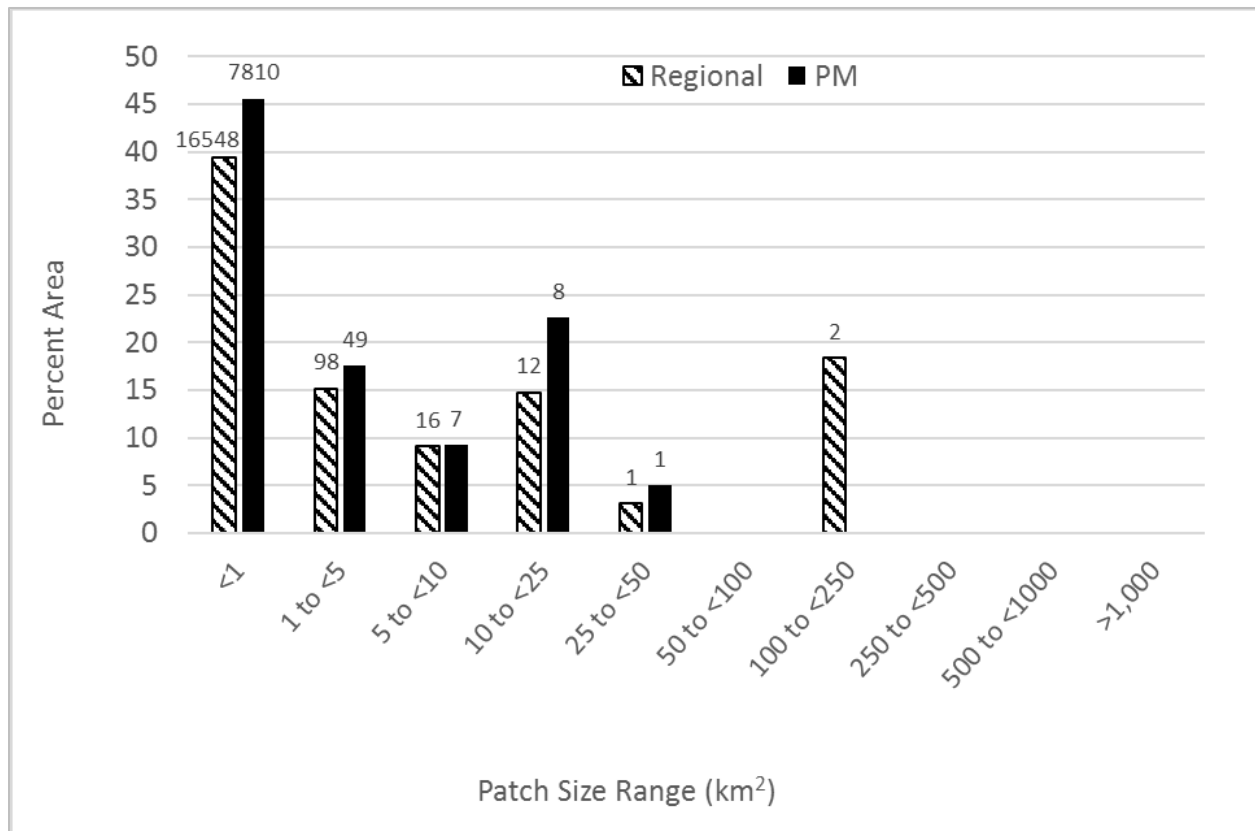


Figure 17. Percentage area within each patch size category for shrublands in the Regional and Park-Manager-Selected (PM) Areas of Analysis in 2011. The number at the top of each bar is the number of patches comprising the area.

Area Density

The majority of forest cover within the Regional AOA occurred in the *Dominant* density class (18.4%) followed closely by the *Patchy* density class (17.5%) (Figure 18; Table A18) in 2011. See the Methods, Table 6, for density class definitions. Similarly, for the Park-Manager-Selected AOA, 21.1% was in the *Dominant* density class, 16.6% was *Patchy*, and 16.0% was *Intact* (Table A18).

Grasslands and shrublands were predominantly in the *Patchy* density class (Figures 19 and 20; Tables A19 and A20).

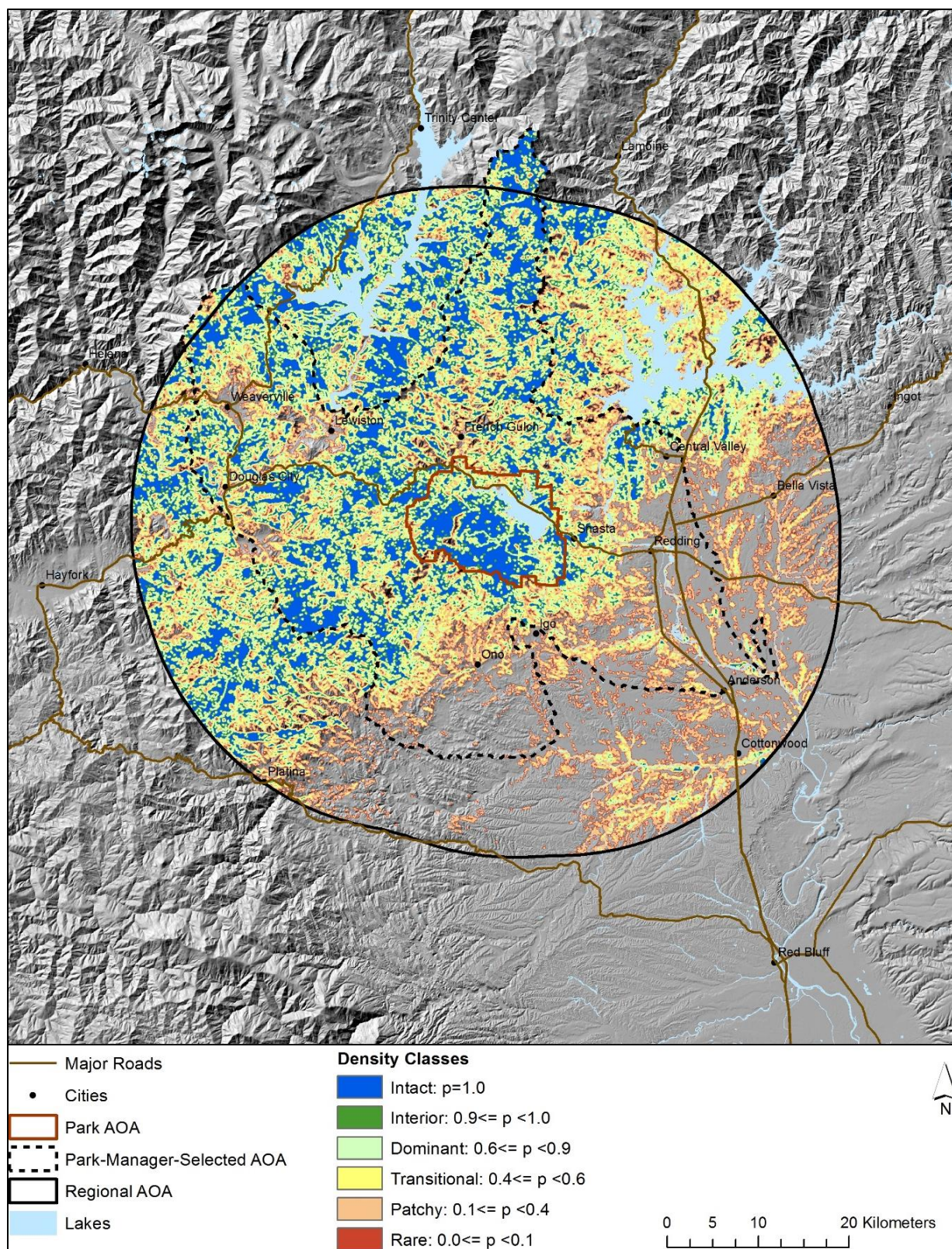


Figure 18. National Land Cover Data forest density classes for Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2011.

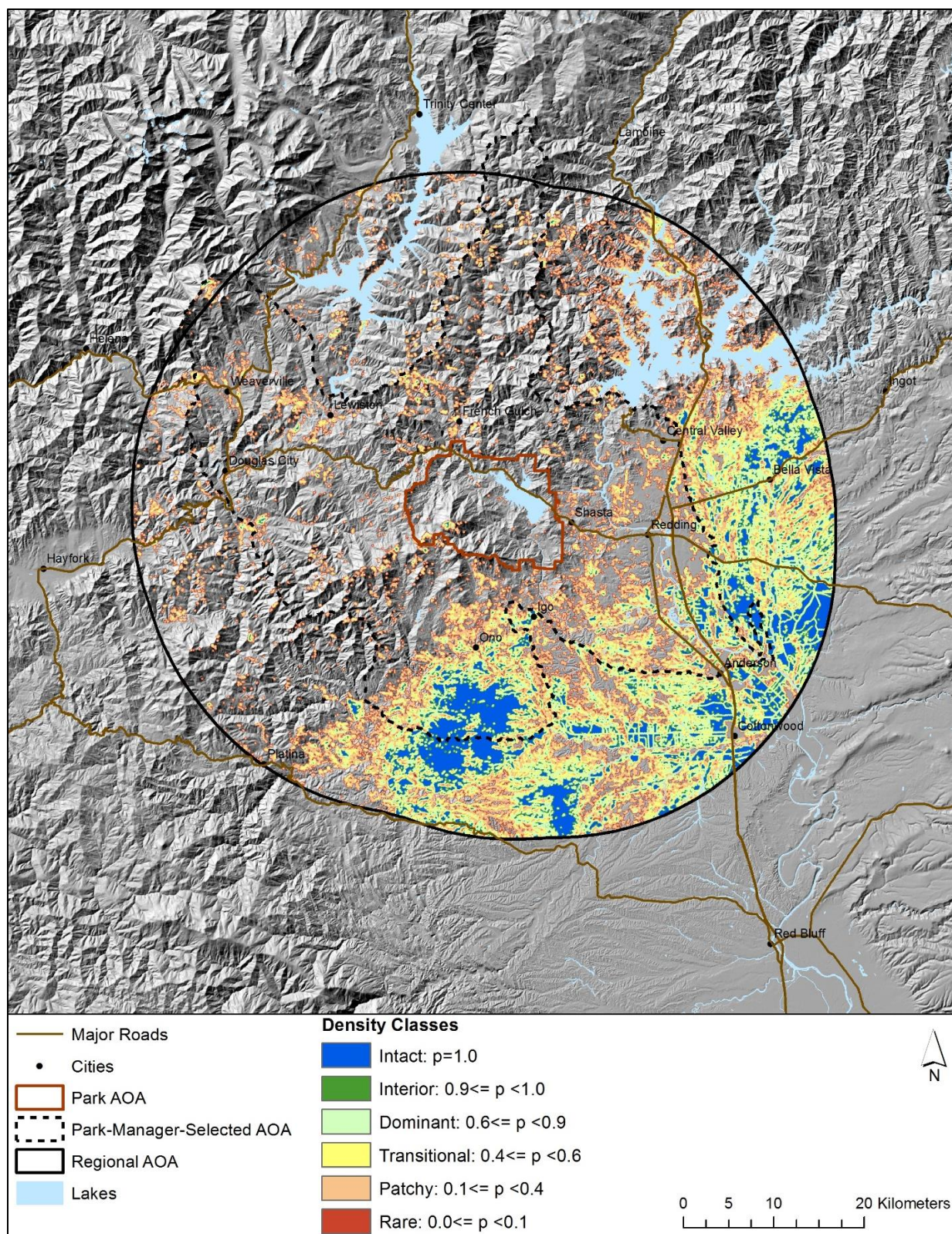


Figure 19. National Land Cover Data grassland density for Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2011.

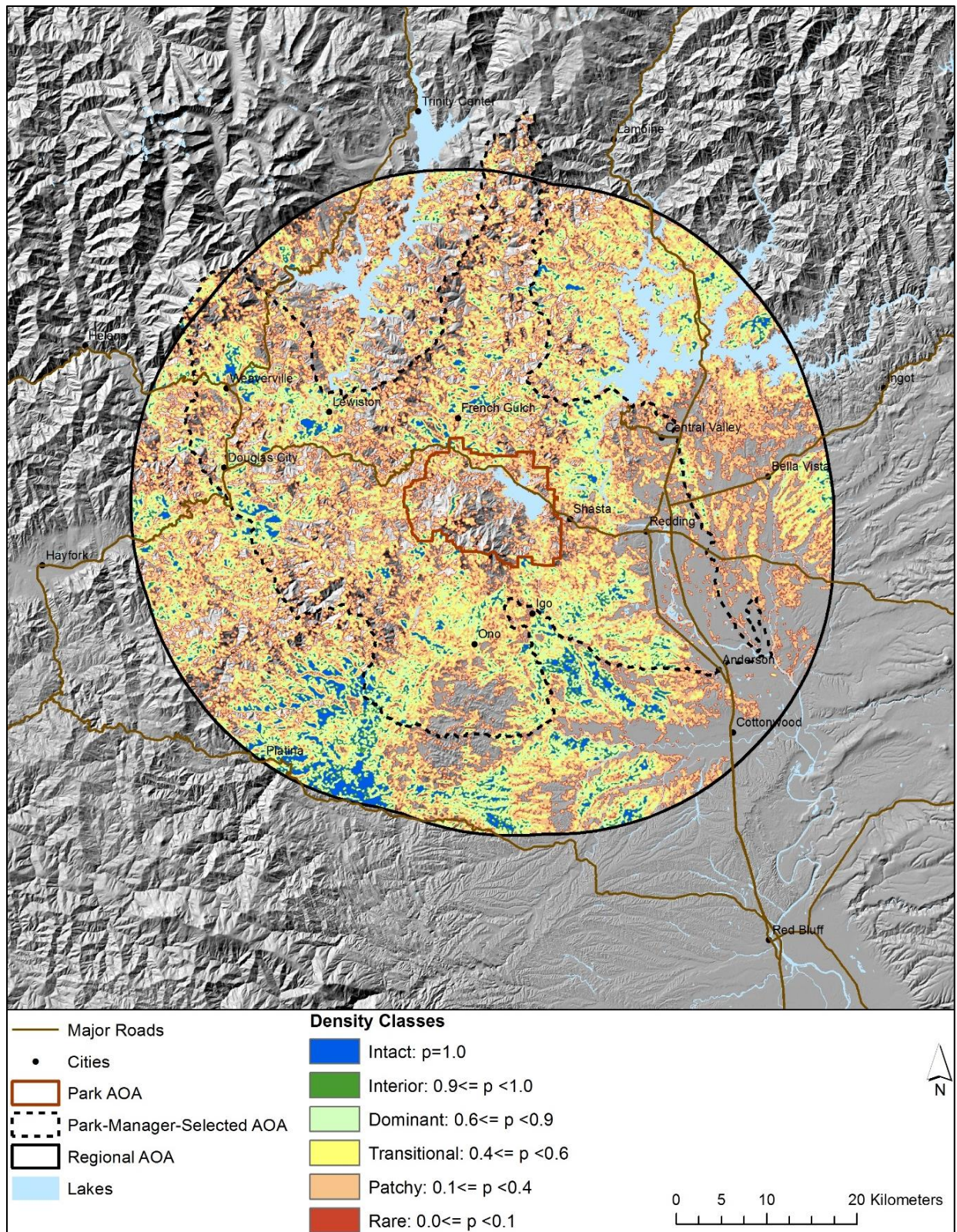


Figure 20. National Land Cover Data shrubland density for Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2011.

Housing and Population

Housing Density

Whiskeytown is surrounded by housing developments, mostly categorized as *Rural* (<7 units/km²) (see Methods, Table 7, for housing density categories). Housing density increased in cities and towns along the Interstate 5 corridor from 2006 to 2011 (Figure 21). The Regional AOA encompasses many towns including Redding, Shasta, Shasta Lake, Anderson, and Weaverville.

Since 1970, the area considered *Rural* has decreased. In 1970, this area comprised 88.6% of the Census areas within the Regional AOA and over 82.0% in the Park-Manager-Selected AOA (Tables A21 and A22, Figures 22 and 23). By 2010, *Rural* area decreased to 67.9% of the Regional AOA and 69.7% of the Park-Manager-Selected AOA.

During the same time frame, the *Exurban* class (7–145 units/ km²) increased from 9.7% to 28.6% in the Regional AOA and from 14.3% to 23.7% in the Park-Manager-Selected AOA. The *Suburban* class (146–1234 units/ km²) increased slightly, from 0.7% to 2.3% in the Regional AOA and from 1.5% to 4.2% in the Park-Manager-Selected AOA.

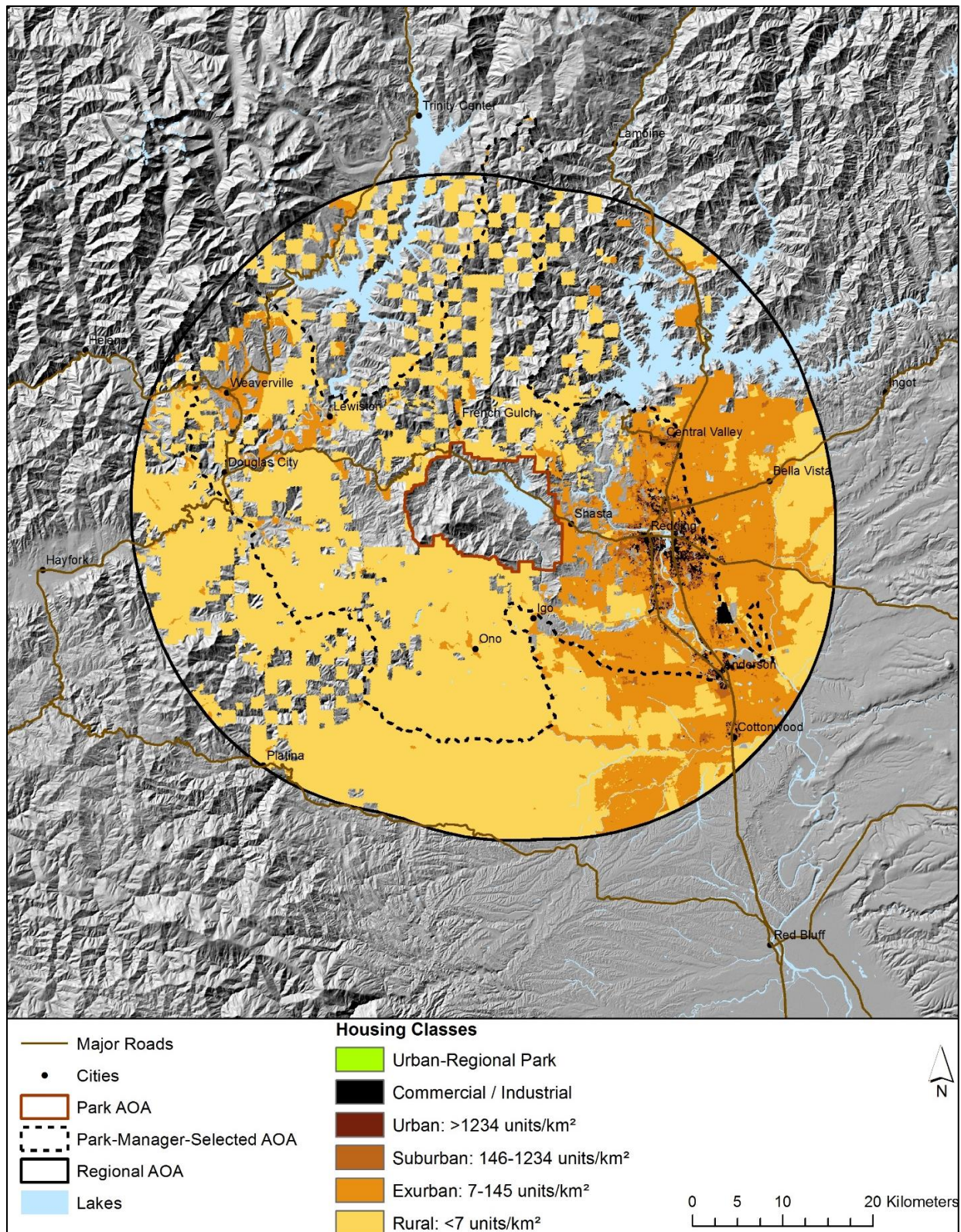


Figure 21. Housing classes in the Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2010. No data exist for gray areas.

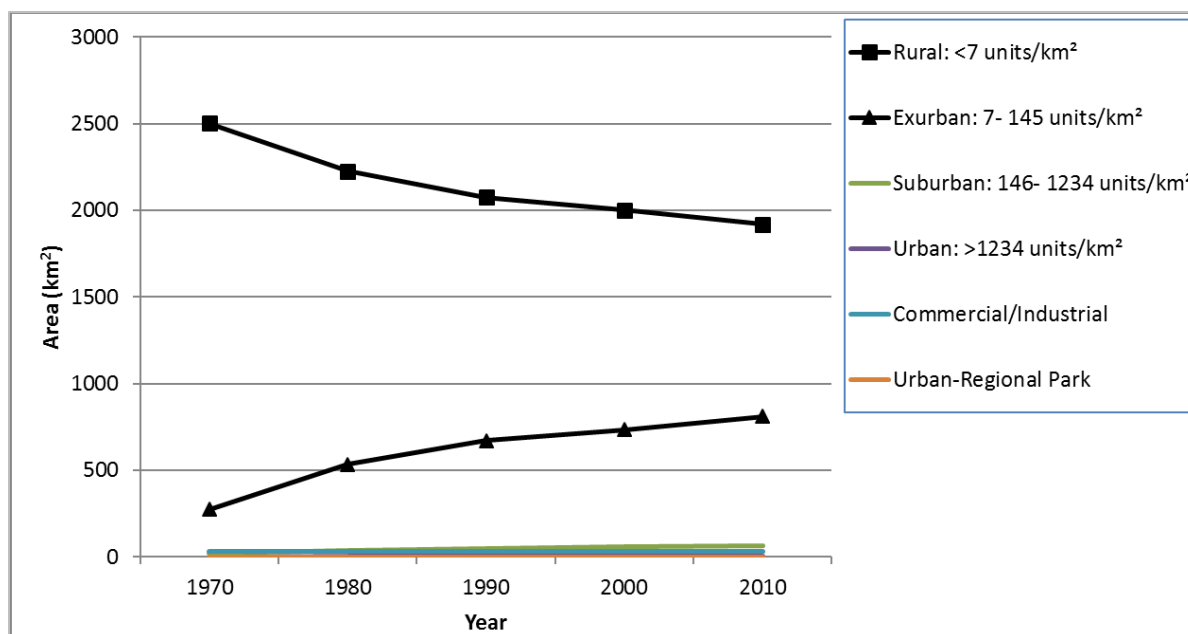


Figure 22. Area (km²) in each housing class from 1970 to 2010 in the Regional Area of Analysis.

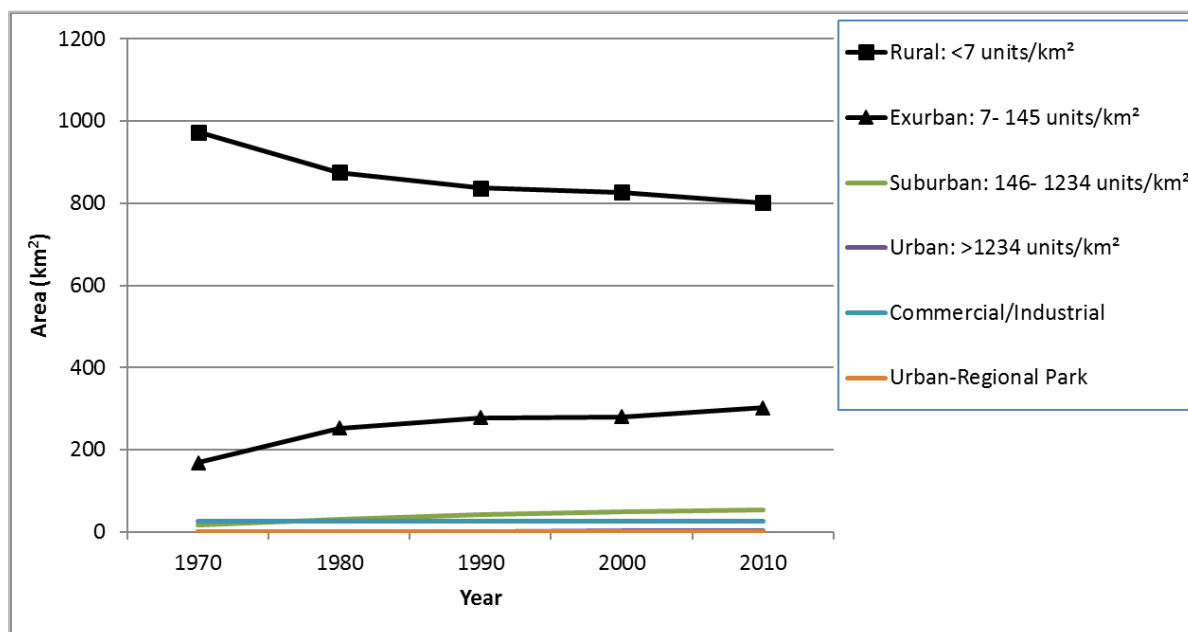


Figure 23. Area (km²) in each housing class from 1970 to 2010 in the Park-Manager-Selected Area of Analysis.

Total Population

Between 1990 and 2010, the population increased by 22% in the Regional AOA, and by 26% in the Park-Manager-Selected AOAs. The population within the Regional AOA was approximately 136,965 in 1990, 153,489 in 2000, and 167,252 in 2010 (Figure 24; Table A23). The population within the Park-Manager-Selected AOA was 99,894 in 1990, 112,108 in 2000, and 125,777 in 2010 (Table A24).

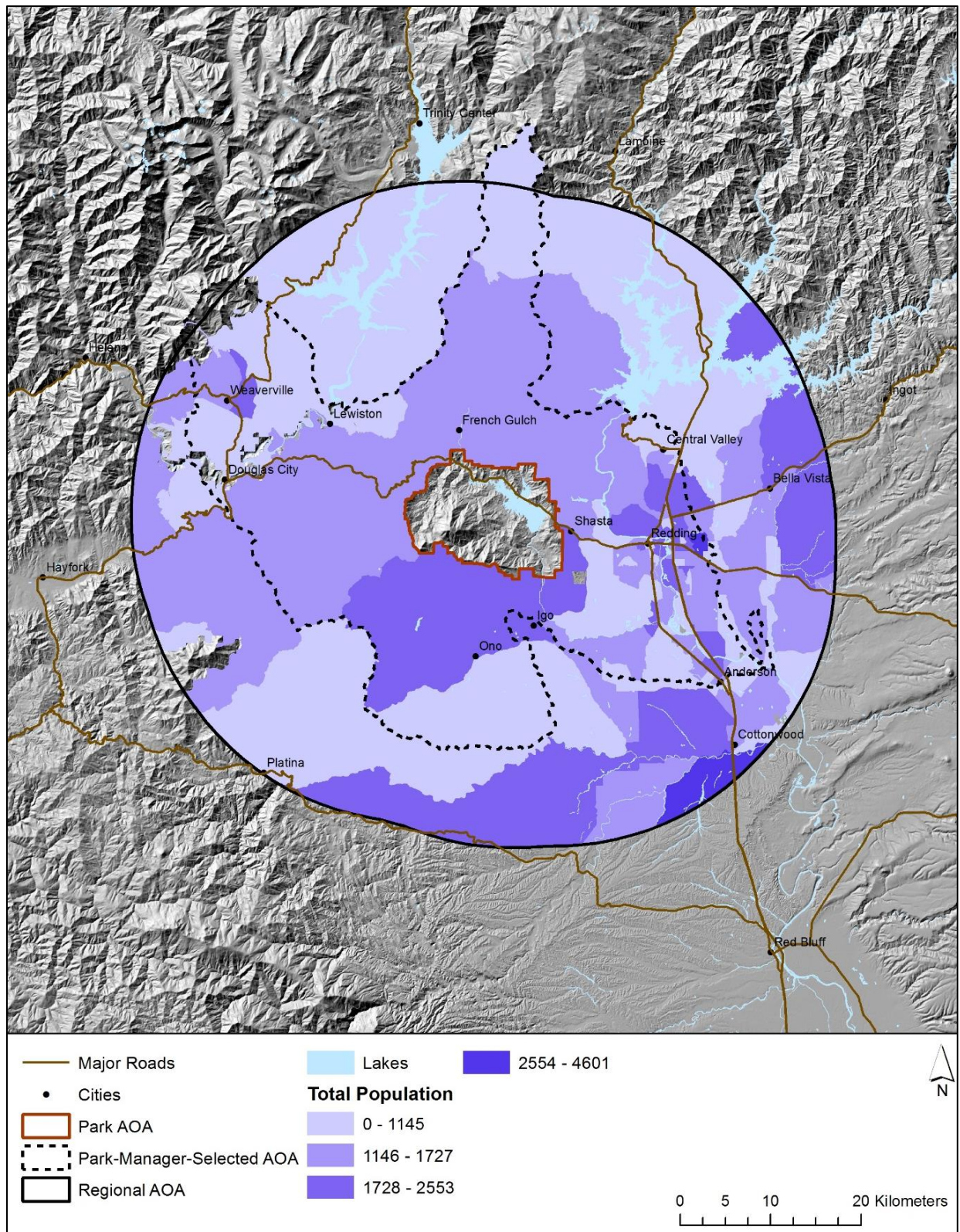


Figure 24. Total population in the Regional and Park-Manager-Selected Areas of Analysis (AOA) in 2010.

Population Density

The population density (individuals per square kilometer) for the Regional AOA increased from 32.6 in 1990, to 36.5 in 2000, to 39.8 in 2010 (Figures 25 and 26; Table A23). The population density for the Park-Manager-Selected AOA increased from 56.8 in 1990, to 63.8 in 2000, to 71.5 in 2010 (Figures 25 and 26; Table A24).

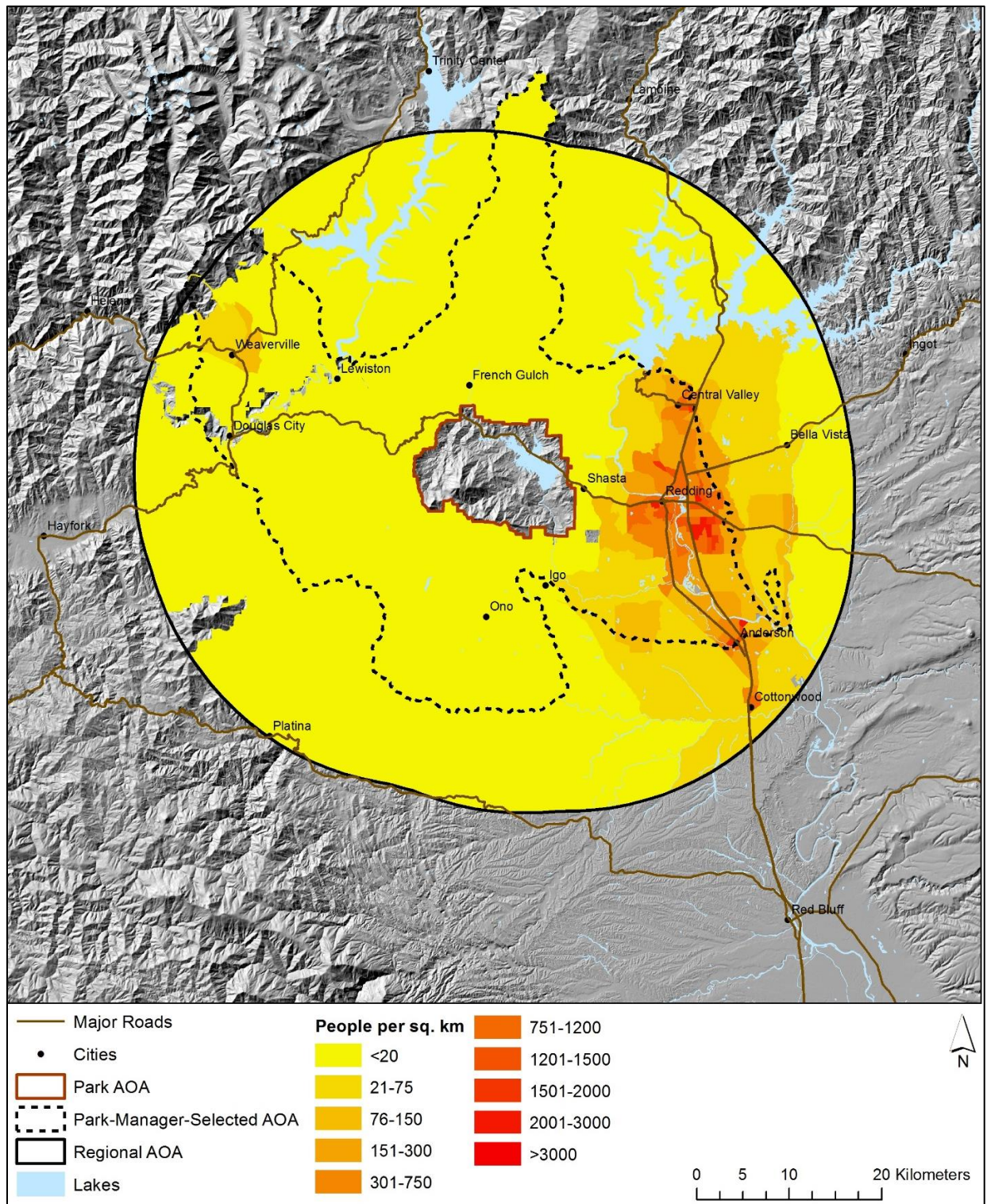


Figure 25. Population density from Census Block-Groups that intersect the Regional and Park-Manager-Selected Areas of Analysis (AOAs) in 2010. Areas where people are assumed to be absent were masked out; this included water and PAD-US protected areas (status 1 and 2—areas that maintained primarily in a natural state).

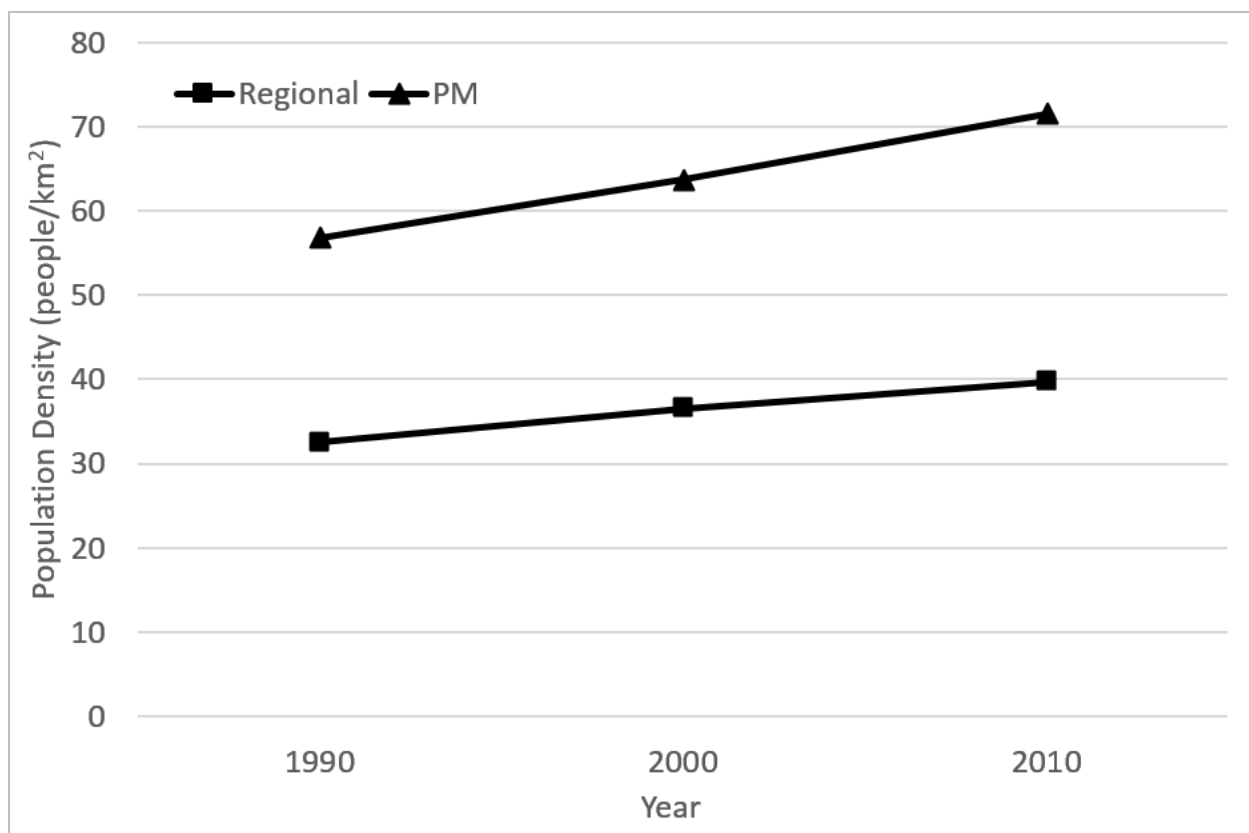


Figure 26. Population density (people/km²) from 1990 to 2010 at Regional and Park-Manager-Selected (PM) Areas of Analysis. Areas where people are assumed to be absent were masked out; this included water and PAD-US protected areas (status 1 and 2—areas that maintained primarily in a natural state).

Roads

As noted in the Methods, the TIGER data we use for road metrics are not always up to date, but they do provide a consistent data source across time and space.

Road Density

The vast majority of roads surrounding the park are category S1400 (Local Neighborhood Road, Rural Road, City Street; see Methods, Table 8, for road code definitions). The S1400 category includes US Forest Service roads.

Between 2010 and 2015, road density decreased slightly in both the Regional and Park-Manager-Selected AOAs. Regional AOA road density was 1.61 in 2010 and 1.58 in 2015 (Figures 27 and 28; Table A25). Park-Manager-Selected AOA road density was 1.84 in 2010 and 1.81 in 2015 (Figures 27 and 28, Table A26). Note that this slight decrease in road density over time is surprising and may reflect a problem with the source data. Park AOA road density was 1.24 in 2016 (Figure 29 and Table A27).

In 2015, total road length in the Regional AOA was 7242.0 km and 3664.1 km in the Park-Manager-Selected AOA. In 2016, total road length was 211.8 km in the Park AOA (Tables A25–A27).

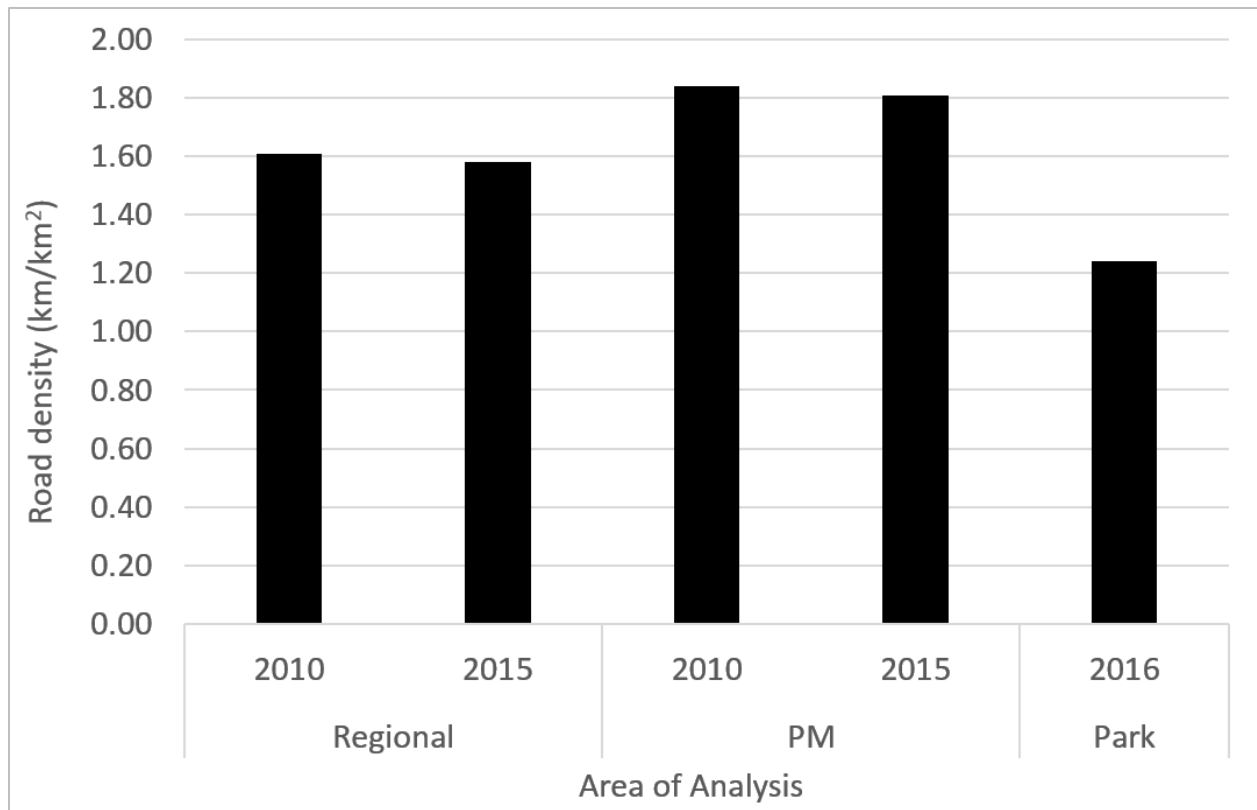


Figure 27. Road density (km/km²) in 2010 and 2015 at the Regional and Park-Manager-Selected (PM) Areas of Analysis (AOA), and in 2016 at the Park AOA. Note that the 2016 Park analysis was done with Whiskeytown NRA-supplied data, whereas the Regional and Park-Manager-Selected analyses were done with US Census Bureau TIGER data.

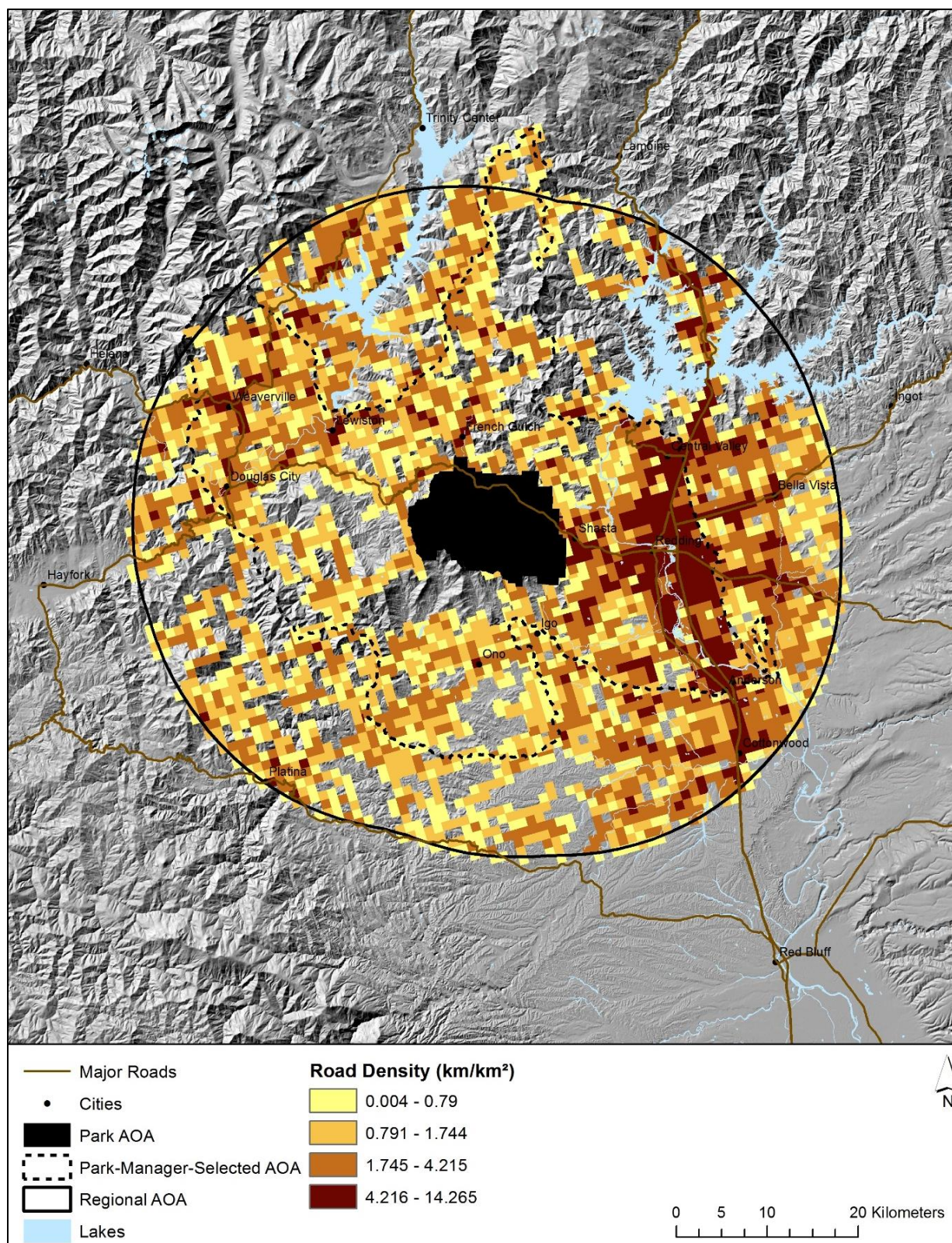


Figure 28. Road density (km/km²) using 2015 US Census Bureau TIGER data at the Regional and Park-Manager-Selected Areas of Analysis (AOA). See Figure 29 for Park AOA.

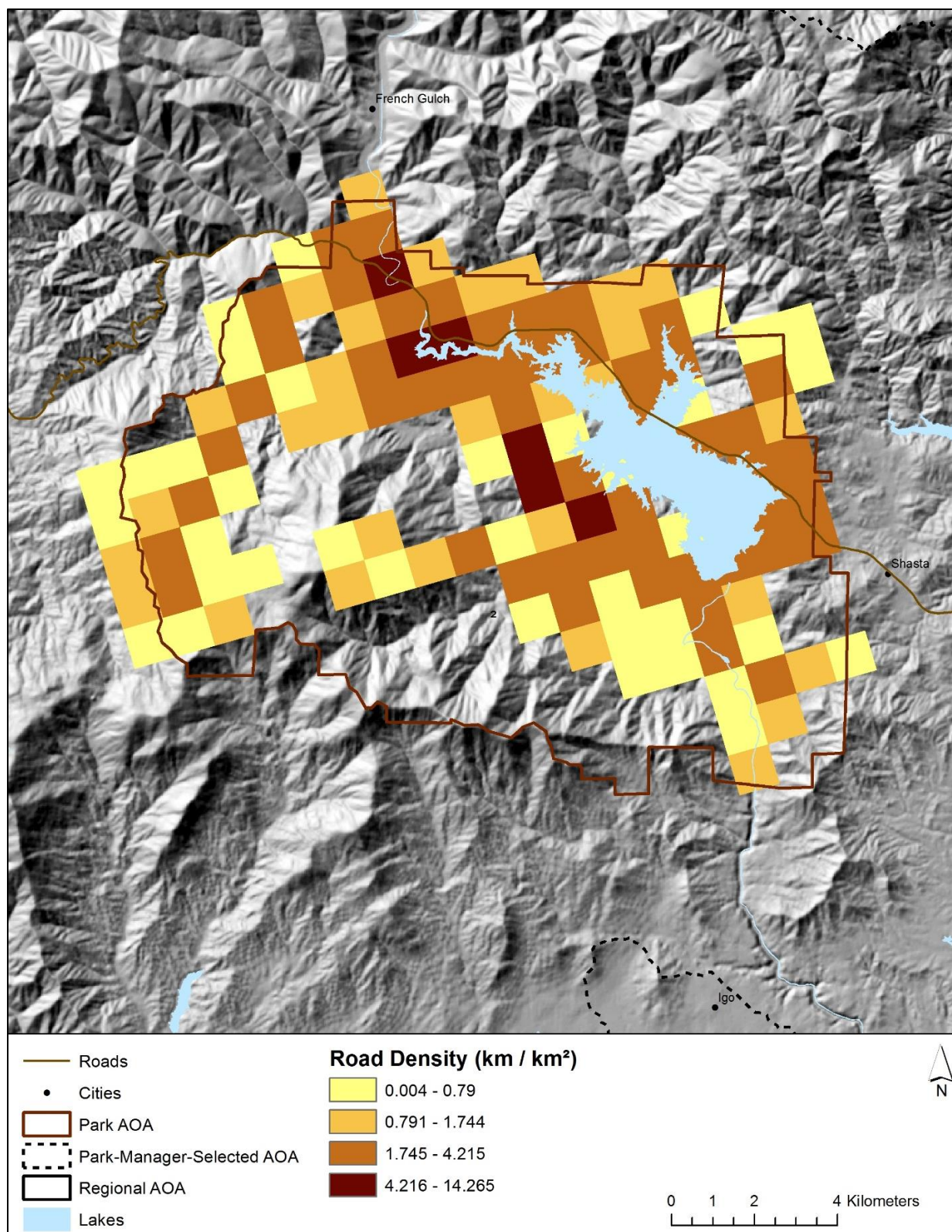


Figure 29. Road density (km/km²) using 2016 Whiskeytown NRA data within the Park Area of Analysis (AOA).

Distance from Roads

Most of the areas that were far from roads were outside Whiskeytown (Figures 30 and 31). To the north of the park, these areas were primarily additional units of Whiskeytown-Shasta-Trinity National Recreation Area and Shasta-Trinity National Forest. To the south, there were some state and private lands that were far from roads.

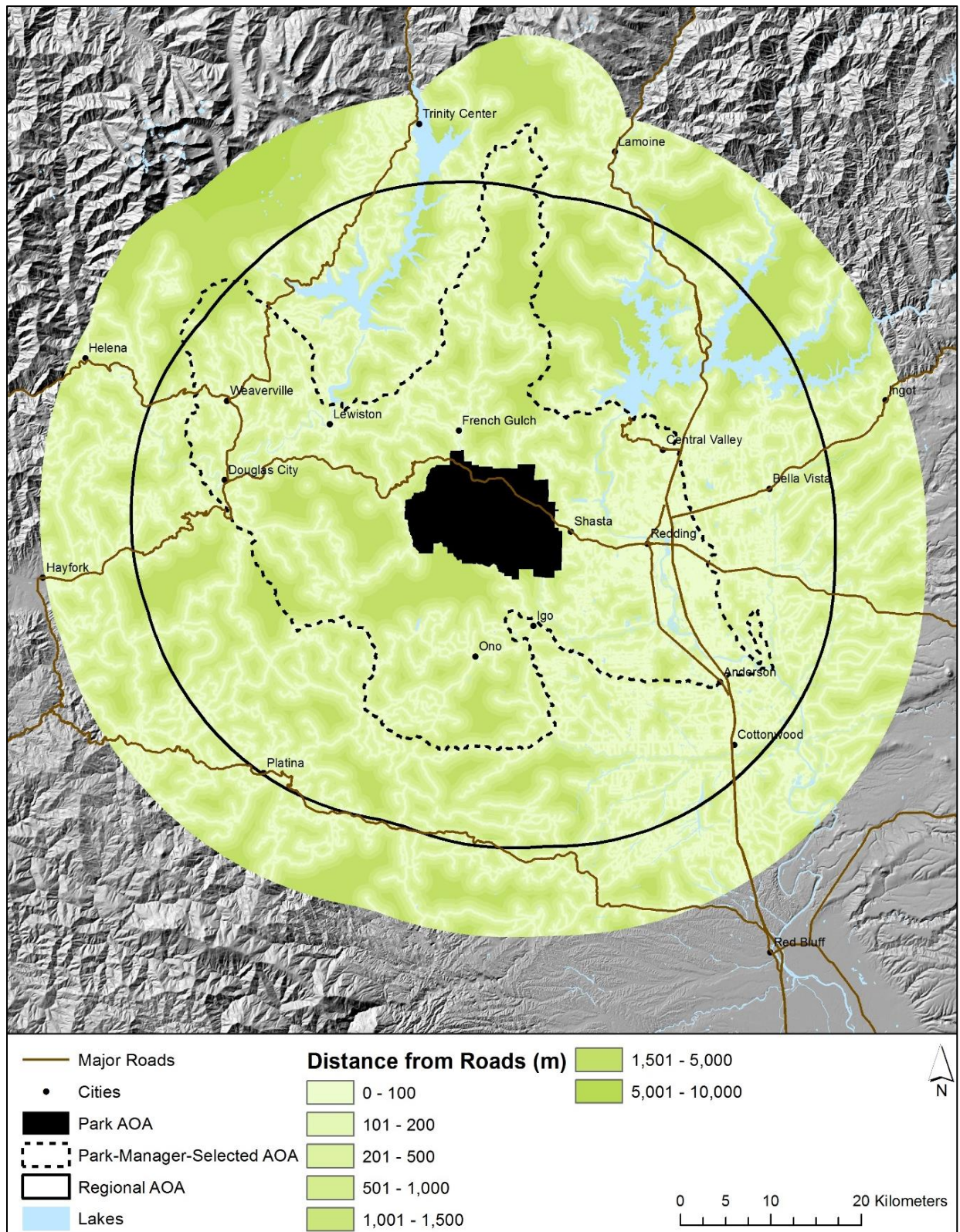


Figure 30. Distance from roads using 2015 US Census Bureau TIGER data in the Regional and Park-Manager-Selected Areas of Analysis (AOA). See Figure 31 for Park AOA.

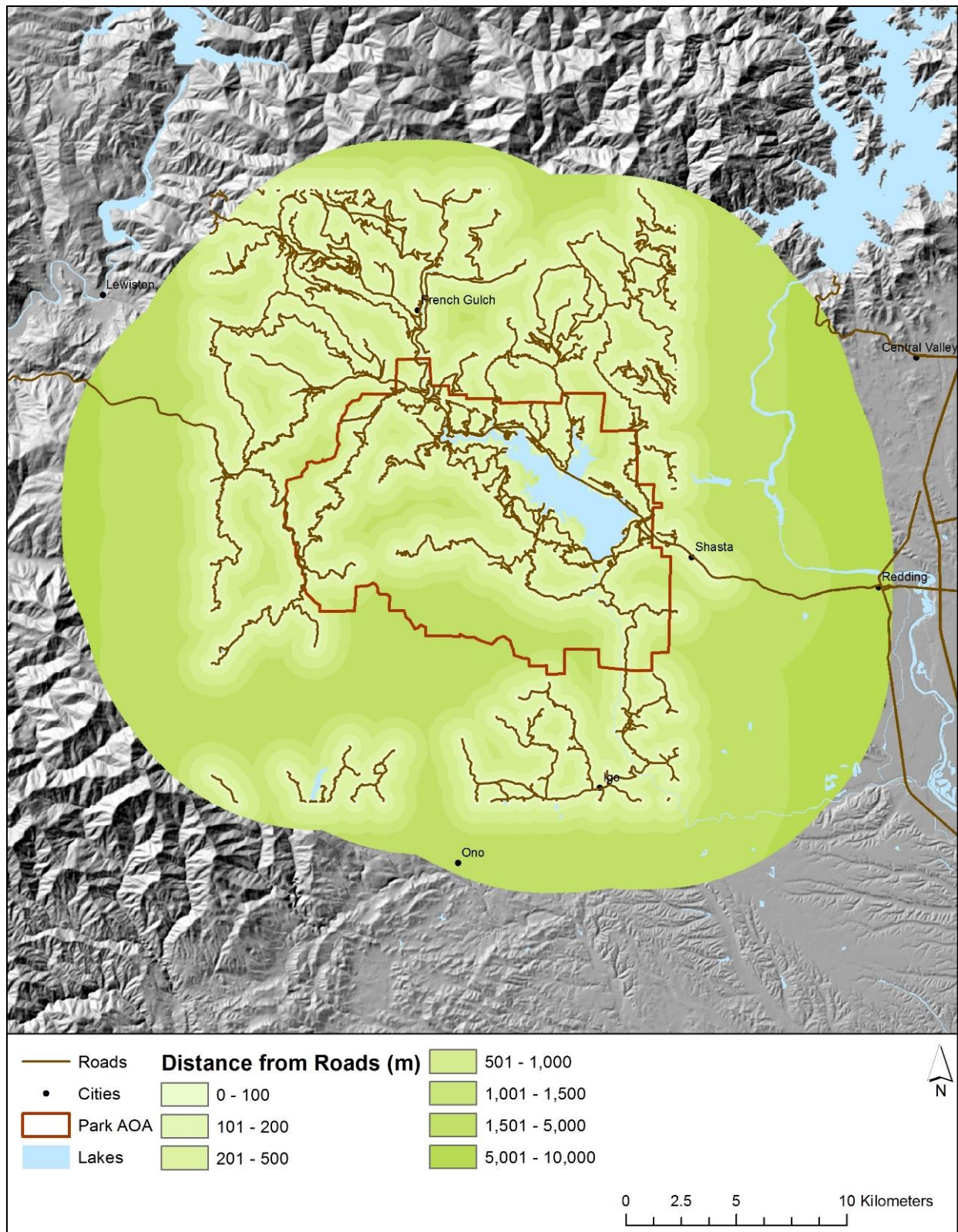


Figure 31. Distance from roads using 2016 Whiskeytown NRA data within the Park Area of Analysis (AOA).

Roadless Areas

The bulk of the roadless areas (patches) were in the southern part of the park and extend south through private lands. Other roadless areas were within the Shasta-Trinity National Forest.

There has been little change in roadless areas between 2010 and 2015. In both 2010 and 2015, the Regional AOA contained seven patches greater than 100 km², totaling approximately 1330 km² (Figure 32; Table A28). The Park-Manager-Selected AOA also contained large roadless areas. In both 2010 and 2015, four roadless patches greater than 100 km² existed and had a total area of approximately 600 km² (Figure 32; Table A29). Within the Park AOA (2016 data), there is one continuously roadless area covering 75.6 km² (Figure 33; Table A30); the rest fall within the 1–10 km² category.

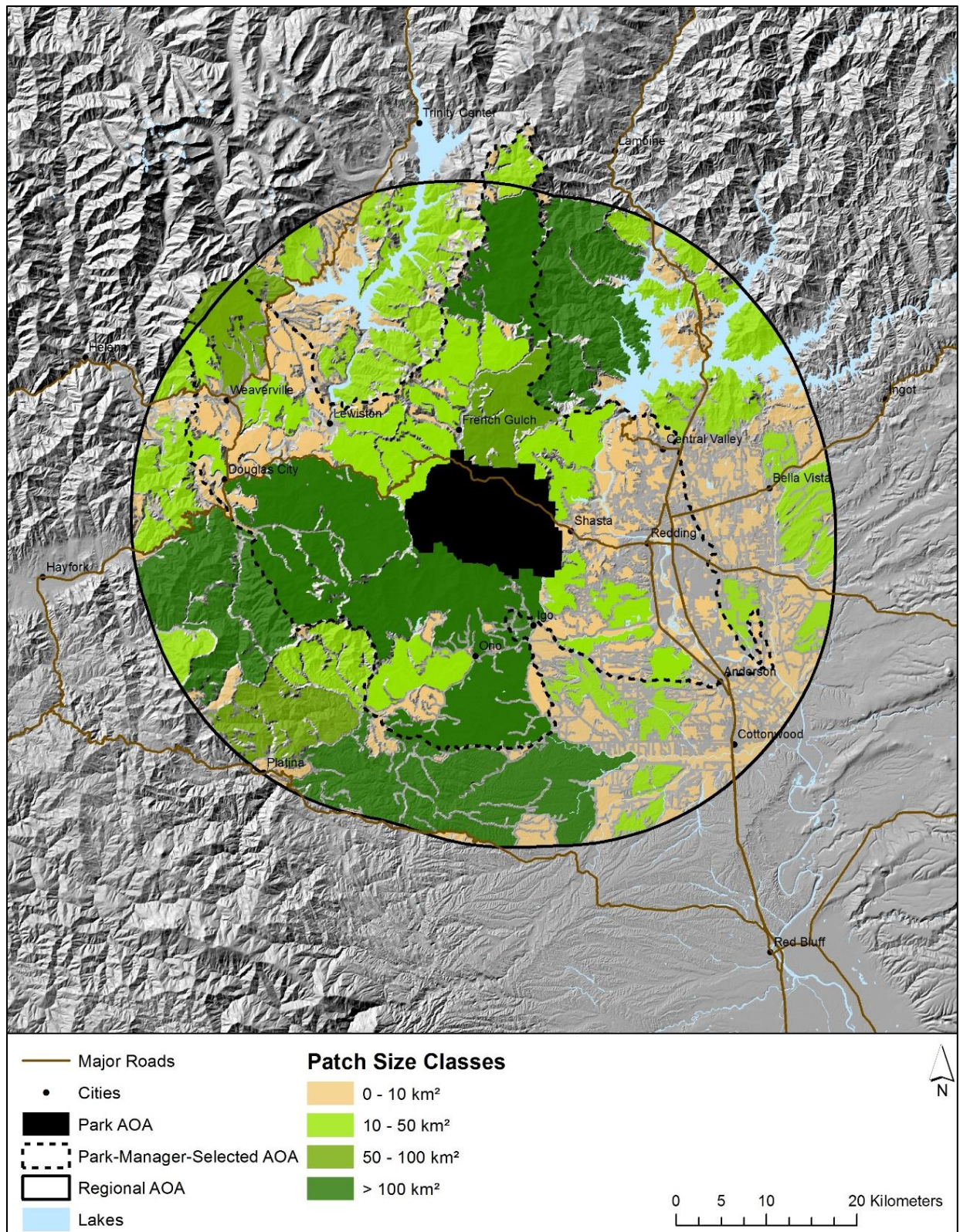


Figure 32. Roadless areas using 2015 US Census Bureau TIGER data for the Regional and Park-Manager-Selected Areas of Analysis (AOA). See Figure 33 for Park AOA.

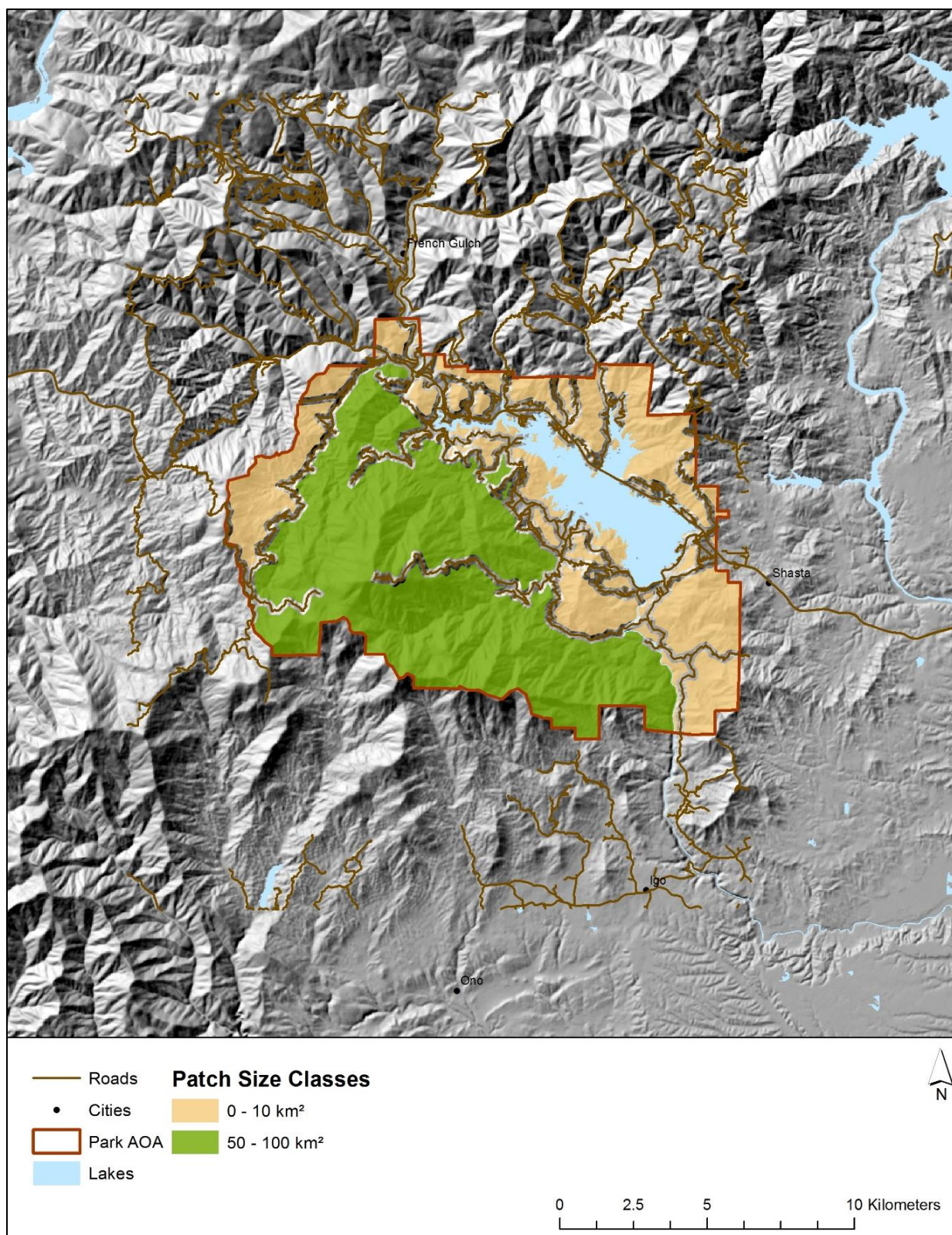


Figure 33. Roadless areas, using 2016 Whiskeytown NRA data within the Park Area of Analysis (AOA).

Disturbance

In the Regional AOA, a cumulative total area of 1046.2 km² was disturbed from 1999 to 2012 (Tables A31–A33). Figure 34 shows disturbed area by year within each of the three AOAs. *Wildfire* affected the most area (798.8 km²), followed by *Unknown* (68.9 km²), and then *Harvest* (67.8 km²) (see Methods, Table 9, for disturbance category definitions). These account for 76.3%, 6.6%, and 6.5%, respectively, of the total disturbed areas within the Regional AOA. Figure 35 presents percentage in each disturbance category for each AOA, and Figure 36 illustrates areas affected by each disturbance type.

In the Park-Manager-Selected AOA, from 1999 to 2012, the total disturbed area was 520.9 km². (Figure 34; Tables A34–A36). *Wildfire* affected the most area (378.71 km²), followed by *Harvest* (47.28 km²), and then *Unknown* (35.0 km²). These account for 72.7%, 9.1%, and 6.7%, respectively, of the disturbed areas within the Park-Manager-Selected AOA (Figures 35 and 36).

For the Park AOA, from 1999 to 2012, the total disturbed area was 76.1 km² (Figure 34; Tables A37–A39). *Wildfire* affected the most area (62.3 km²). This disturbance type accounts for 81.8% of all disturbed areas within the Park AOA (Figures 35 and 36).

Figures 37 through 38 plot the area affected by each of the largest disturbance types over time within the Regional and Park-Manager-Selected AOAs, respectively.

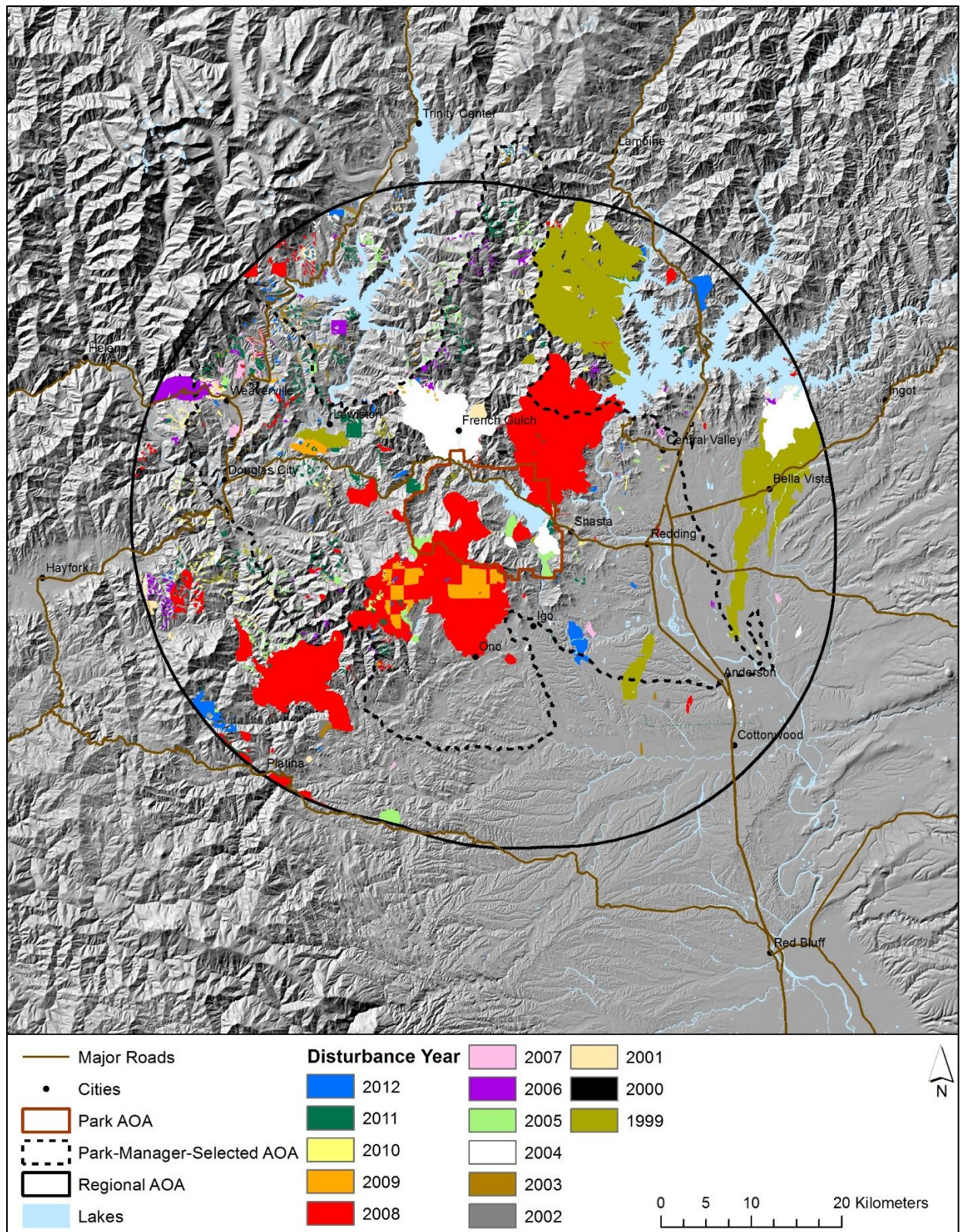


Figure 34. Locations of disturbances by year (1999–2012) at Regional, Park-Manager-Selected, and Park Areas of Analysis (AOA).

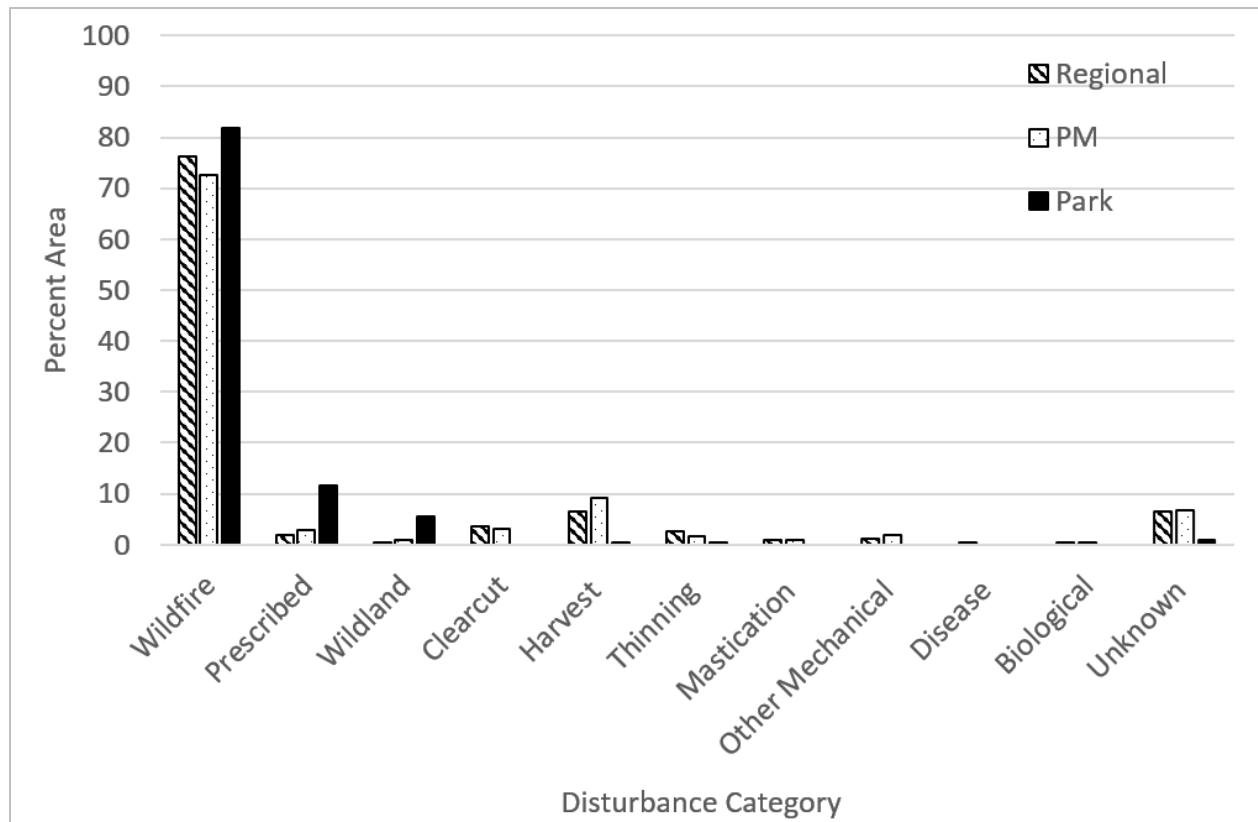


Figure 35. Percentage area (area disturbed/total disturbed area for that Area of Analysis (AOA)) affected by each disturbance type from 1999 to 2012, at the Regional, Park-Manager-Selected (PM), and Park Areas of Analysis.

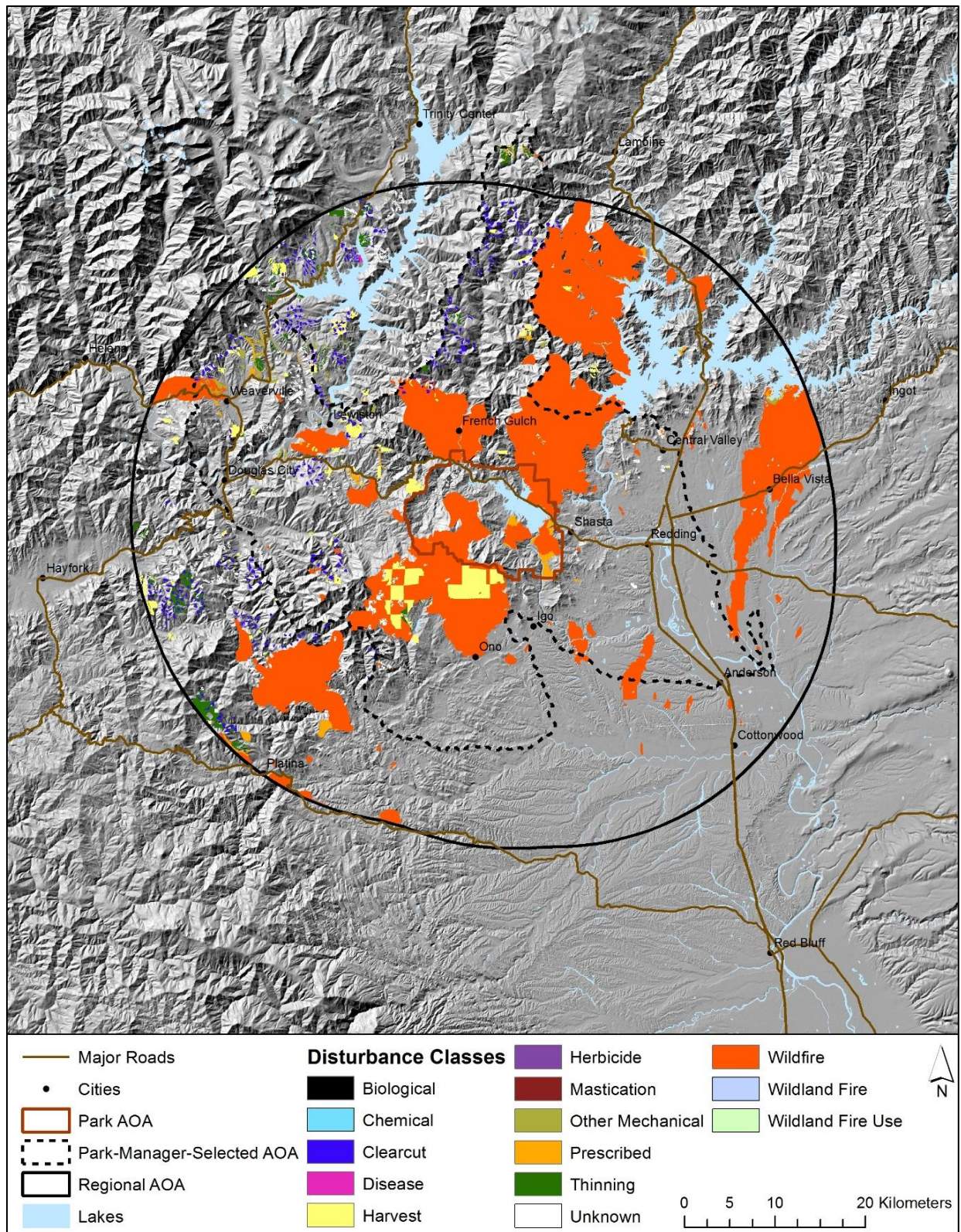


Figure 36. Areas affected by different disturbance types from 1999 to 2012, for Regional, Park-Manager-Selected, and Park Areas of Analysis (AOA).

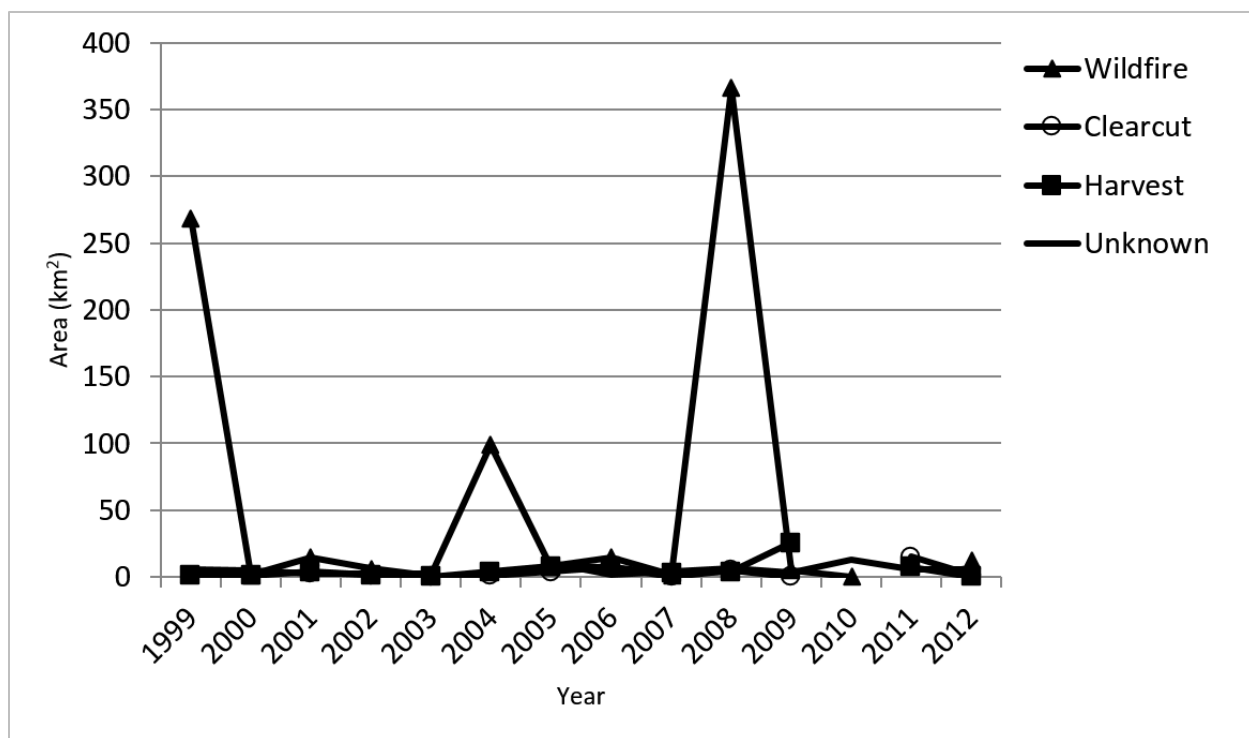


Figure 37. Total area (km²) affected by the four largest disturbance types, by year, for the Regional Area of Analysis. Complete disturbance type values are in Tables A31–A33.

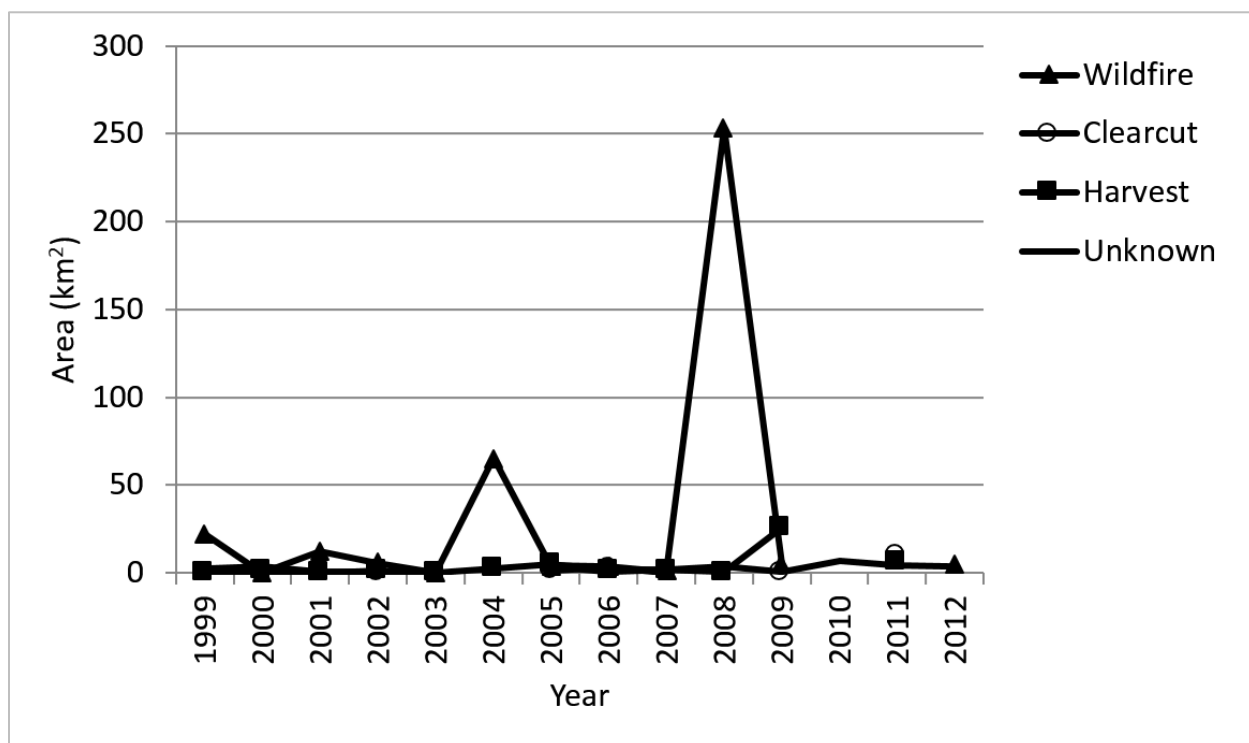


Figure 38. Total area (km²) affected by the four largest disturbance types, by year, for the Park-Manager-Selected Area of Analysis. Complete disturbance type values are in Tables A34–A36.

Discussion

This report summarizes landscape level information about Whiskeytown and its surrounding areas from largely regional- and national-level datasets. The vegetation within the Park, Regional, and Park-Manager-Selected AOAs is primarily evergreen forest and shrub/scrub. While use or management of the park may degrade the existing areas, the park itself is protected from conversion of natural land (GAP Conservation Status 2); the US Forest Service and BLM lands outside the park were mostly GAP Conservation Status 3, which means that even though the area has protection from conversion of natural land, extractive use is allowed. There were some wilderness areas near the park that were GAP Conservation Status 1, which protects them from conversion of natural land and where disturbances are allowed and/or mimicked. There were numerous small, forested patches in the park and the northern part of the Regional and Park-Manager-Selected AOAs, with some slightly larger grassland areas south of the park. Shrublands were distributed throughout the area. Most of the AOAs were considered to be in natural condition, with few impervious surfaces. There were roads in and around the park, however, and increasing population and housing outside the park. A variety of disturbances have occurred, including logging outside the park. The biggest disturbance was fire.

As mentioned in the Methods, TIGER data are not always kept up to date and may therefore be inaccurate. For future analyses, it would be highly beneficial for parks to update the US Census Bureau TIGER dataset with current park data.

Looking at individual indicators and how they change over time can provide useful information to land managers. While the individual statistics are important, there is also power in taking an integrated approach. A land manager could look for correlation and causation by examining individual landscape changes along with data from other indicators such as disturbances, protection status and ownership, housing, and landscape patterns. In addition, integrating these data with finer scale projects, including vegetation and land bird monitoring surveys, detailed vegetation maps, and park-specific projects (such as prescribed burning and invasive plant management actions), can help provide an integrated look at ecosystem dynamics.

Managers can also compare what is occurring inside park boundaries with conditions outside of the park. This provides park staff with information that can potentially be used to work with neighboring land managers to protect areas that may be important for the preservation of resources.

This report for Whiskeytown summarizes data from 2006 to 2016 (varies by indicator) and was developed as a “proof of concept” for the Klamath Network land cover and land use protocol, which strives to provide the best data and a detailed analysis to the park in a time and cost-efficient manner. The next report will summarize results from the forthcoming national Inventory and Monitoring Landscape Dynamics protocol, as implemented for Klamath Network parks in 2021. Monitoring land cover and land use will continue to be a team effort between specialists in the park, Inventory and Monitoring staff (Central Office, Klamath Network), and the national landscape dynamics protocol staff.

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Appendix A: Data Tables

Table A1. Area and percentage of AOA attributed to different landowners for the Regional and Park-Manager-Selected AOAs, using USGS Gap Analysis Program (GAP), Protected Areas Database for US (PAD-US) 2012 data. *Note that the percentage could be larger depending on the composition of the unavailable data.

Owner Name	Regional		Park-Manager-Selected	
	Area (km ²)	Minimum percentage of AOA*	Area (km ²)	Minimum percentage of AOA*
Forest Service (USFS)	955.67	20.84	200.71	9.90
Bureau of Land Management (BLM)	470.41	10.26	379.37	18.71
National Park Service (NPS)	170.67	3.72	170.67	8.42
Bureau of Reclamation (BOR)	19.30	0.42	19.30	0.95
City Land	9.26	0.20	7.53	0.37
Other State Land	6.54	0.14	1.28	0.06
State Fish and Wildlife	3.50	0.08	2.29	0.11
Private Landowner	1.45	0.03	1.30	0.06
Unknown	0.14	<0.01	0.14	0.01
Native American Land	0.11	<0.01	0.11	0.01
Unavailable Data	2949.71	64.31	1244.64	61.39

Table A2. Area (km²) and minimum percentage of AOA attributed to USGS Gap Analysis Program (GAP) Protected Areas Database for the US (PAD-US) conservation status rankings for the Regional and Park-Manager-Selected AOAs in 2012. *Note that the percentage could be larger depending on the composition of the unavailable data.

Status	Description	Regional		Park-Manager-Selected	
		Area (km ²)	Minimum percentage of AOA*	Area (km ²)	Minimum percentage of AOA*
1	Managed for biodiversity, natural disturbance allowed	60.15	1.31	38.36	1.89
2	Managed for biodiversity, natural disturbance NOT allowed	198.78	4.33	189.61	9.35
3	Managed for multiple use	1370.56	29.88	552.57	27.26
4	No known mandate	7.57	0.16	2.16	0.11
N/A	Unavailable	2949.71	64.31	1244.64	61.39

Table A3. Area and percentage of AOA by National Land Cover Data land cover classes in the Regional AOA for 2006 and 2011.

Level 2	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
Open Water	152.36	3.32	152.92	3.33
Perennial Snow/Ice	0.02	<0.01	0.02	<0.01
Developed, Open Space	209.20	4.56	206.93	4.51
Developed, Low Intensity	50.34	1.10	50.35	1.10
Developed, Medium Intensity	33.65	0.73	36.27	0.79
Developed, High Intensity	8.00	0.17	8.53	0.19
Barren Land	23.34	0.51	25.80	0.56
Deciduous Forest	235.30	5.13	230.39	5.02
Evergreen Forest	1451.48	31.64	1425.51	31.08
Mixed Forest	271.10	5.91	263.35	5.74
Shrub/Scrub	1252.50	27.31	1273.58	27.77
Herbaceous	721.49	15.73	736.34	16.05
Hay/Pasture	114.98	2.51	114.52	2.50
Cultivated Crops	26.14	0.57	25.37	0.55
Woody Wetlands	36.06	0.79	36.05	0.79
Herbaceous Wetlands	0.84	0.02	0.84	0.02

Table A4. Area and percentage of AOA by National Land Cover Data land cover classes in the Park-Manager-Selected AOA for 2006 and 2011.

Level 2	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
Open Water	22.17	1.09	22.74	1.12
Perennial Snow/Ice	0.09	<0.01	0.09	<0.01
Developed, Open Space	114.92	5.67	113.22	5.58
Developed, Low Intensity	39.37	1.94	39.36	1.94
Developed, Medium Intensity	28.13	1.39	30.19	1.49
Developed, High Intensity	6.41	0.32	6.86	0.34

Table A4 (continued). Area and percentage of AOA by National Land Cover Data land cover classes in the Park-Manager-Selected AOA for 2006 and 2011.

Level 2	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
Barren Land	7.83	0.39	8.57	0.42
Deciduous Forest	118.60	5.85	115.58	5.70
Evergreen Forest	747.19	36.86	731.69	36.09
Mixed Forest	185.60	9.16	180.14	8.89
Shrub/Scrub	532.24	26.25	544.06	26.84
Herbaceous	194.79	9.61	205.06	10.12
Hay/Pasture	13.67	0.67	13.59	0.67
Cultivated Crops	8.36	0.41	8.23	0.41
Woody Wetlands	7.44	0.37	7.43	0.37
Herbaceous Wetlands	0.48	0.02	0.47	0.02

Table A5. Area and percentage of Areas of Analysis by National Land Cover Data classes in the Park AOA for 2006 and 2011.

Level 2	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
Open Water	11.81	6.92	12.24	7.18
Developed, Open Space	6.30	3.70	6.29	3.69
Developed, Low Intensity	0.66	0.39	0.64	0.37
Developed, Medium Intensity	0.07	0.04	0.10	0.06
Developed, High Intensity	0.02	0.01	0.02	0.01
Barren Land	0.08	0.05	0.11	0.06
Deciduous Forest	18.36	10.77	18.01	10.56
Evergreen Forest	89.42	52.44	87.85	51.52
Mixed Forest	17.94	10.52	17.64	10.35
Shrub/Scrub	23.78	13.95	25.37	14.88
Herbaceous	1.21	0.71	1.39	0.82
Woody Wetlands	0.66	0.38	0.66	0.38
Herbaceous Wetlands	0.21	0.12	0.20	0.12

Table A6. Area and percentage of AOA by Impervious Surface class in the Regional AOA, for 2006 and 2011.

Impervious Surface	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
0% - 2%	4356.56	94.98	4355.23	94.95
2% - 4%	46.54	1.01	46.04	1.00
4% - 6%	22.88	0.50	22.54	0.49
6% - 8%	16.70	0.36	16.38	0.36
8% - 10%	12.70	0.28	12.38	0.27
10% - 15%	21.63	0.47	21.06	0.46
15% - 25%	24.65	0.54	24.00	0.52
25% - 50%	42.53	0.93	42.76	0.93
50% - 100%	42.59	0.93	46.41	1.01

Table A7. Area and percentage of AOA by Impervious Surface class in the Park-Manager-Selected AOA, for 2006 and 2011.

Impervious Surface	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
0% - 2%	1872.53	92.37	1871.44	92.31
2% - 4%	23.77	1.17	23.37	1.15
4% - 6%	14.09	0.70	13.82	0.68
6% - 8%	10.43	0.51	10.18	0.50
8% - 10%	8.05	0.40	7.81	0.39
10% - 15%	13.88	0.68	13.46	0.66
15% - 25%	16.73	0.83	16.24	0.80
25% - 50%	32.51	1.60	32.71	1.61
50% - 100%	35.32	1.74	38.29	1.89

Table A8. Area and percentage of AOA by Impervious Surface class in the Park AOA, for 2006 and 2011.

Impervious Surface	2006		2011	
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*
0% - 2%	165.59	97.11	165.58	97.11
2% - 4%	1.36	0.80	1.36	0.80
4% - 6%	0.84	0.49	0.83	0.49
6% - 8%	0.55	0.32	0.55	0.32
8% - 10%	0.38	0.22	0.38	0.22
10% - 15%	0.58	0.34	0.58	0.34
15% - 25%	0.62	0.36	0.62	0.36
25% - 50%	0.48	0.28	0.48	0.28
50% - 100%	0.12	0.07	0.14	0.08

Table A9. Area and percentage of AOA in *Natural* or *Converted* land in the Regional AOA, for 2006 and 2011.

Land Cover Type	2006		2011		% Change in Area
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*	
Natural	4144.48	90.36	4144.81	90.36	0.01
Converted	442.30	9.64	441.97	9.64	-0.07

Table A10. Area and percentage of AOA in *Natural* or *Converted* land in the Park-Manager-Selected AOA, for 2006 and 2011.

Land Cover Type	2006		2011		% Change in Area
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*	
Natural	1816.45	89.60	1815.85	89.57	-0.03
Converted	210.86	10.40	211.46	10.43	0.28

Table A11. Area and percentage of AOA in *Natural* or *Converted* land in the Park AOA, for 2006 and 2011.

Land Cover Type	2006		2011		% Change in Area
	Area (km ²)	Percentage of AOA*	Area (km ²)	Percentage of AOA*	
Natural	163.47	95.86	163.47	95.86	0.00
Converted	7.05	4.14	7.05	4.14	0.00

Table A12. Area, percentage of AOA, and percentage of forest area by forest morphology classification in the Park-Manager-Selected and Regional AOAs for 2011.

Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of AOA*	Percentage of Forested Area	Area (km ²)	Percentage of AOA*	Percentage of Forested Area
Background (non-forested)	992.42	48.95	NA	2631.33	57.37	NA
Branch	40.40	1.99	3.90	81.26	1.77	4.16
Edge	328.69	16.21	31.76	576.98	12.58	29.51
Islet	94.66	4.67	9.15	231.87	5.06	11.86
Core	188.81	9.31	18.24	295.09	6.43	15.09
Bridge	360.06	17.76	34.79	735.28	16.03	37.60
Perforated	7.08	0.35	0.68	8.82	0.19	0.45
Loop	15.21	0.75	1.47	26.13	0.57	1.34

Table A13. Area, percentage of AOA, and percentage of grassland area by pattern morphology classification in the Park-Manager-Selected and Regional AOAs, for 2011.

Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of AOA*	Percentage of Grassland	Area (km ²)	Percentage of AOA*	Percentage of Grassland
Background (non-grassland)	1808.65	89.21	NA	3735.92	81.45	NA
Branch	9.19	0.45	4.20	36.58	0.80	4.30
Edge	35.28	1.74	16.14	175.59	3.83	20.64

Table A13 (continued). Area, percentage of AOA, and percentage of grassland area by pattern morphology classification in the Park-Manager-Selected and Regional AOAs, for 2011.

Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of AOA*	Percentage of Grassland	Area (km ²)	Percentage of AOA*	Percentage of Grassland
Islet	86.48	4.27	39.55	202.62	4.42	23.81
Core	33.82	1.67	15.47	113.45	2.47	13.33
Bridge	43.38	2.14	19.84	296.12	6.46	34.80
Perforated	2.06	0.10	0.94	4.81	0.10	0.57
Loop	8.44	0.42	3.86	21.70	0.47	2.55

Table A14. Area, percentage of AOA, and percentage of shrubland area by pattern morphology classification in the Park-Manager-Selected and Regional AOAs for 2011.

Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of AOA*	Percentage of Shrubland	Area (km ²)	Percentage of AOA*	Percentage of Shrubland
Background (non Shrubland)	1483.25	73.16	NA	3313.23	72.23	NA
Branch	29.06	1.43	5.34	65.96	1.44	5.18
Edge	48.06	2.37	8.83	145.42	3.17	11.42
Islet	253.01	12.48	46.50	548.26	11.95	43.05
Core	9.74	0.48	1.79	39.95	0.87	3.14
Bridge	167.02	8.24	30.70	406.82	8.87	31.94
Perforated				0.21	<0.01	0.02
Loop	37.18	1.83	6.83	66.93	1.46	5.26

Table A15. Count and total area by patch size range for forest in the Park-Manager-Selected and Regional AOAs, for 2011.

Patch Size Range, in km ²	2011 Park-Manager-Selected		2011 Regional	
	Count	Total Area (km ²)	Count	Total Area (km ²)
<1	3288	101.35	8335	224.41
1 to <5	13	26.79	39	78.36
5 to <10	1	6.97	5	32.26
10 to <25	3	60.69	6	119.84
25 to <50	2	56.89	1	35.37
50 to <100	2	163.12	0	0
100 to <250	1	238.07	1	197.62
250 to <500	1	381.03	0	0
500 to <1000	0	0	2	1267.58
>1,000	0	0	0	0
Total	3311	1034.90	8389	1955.44

Table A16. Count and total area by patch size range for grassland in the Park-Manager-Selected and Regional AOAs, for 2011.

Patch Size Range, in km ²	2011 Park-Manager-Selected		2011 Regional	
	Count	Total Area (km ²)	Count	Total Area (km ²)
<1	3368	100.34	8014	218.14
1 to <5	13	37.48	42	85.23
5 to <10	0	0	8	60.16
10 to <25	1	10.89	6	105.23
25 to <50	0	0	3	109.15
50 to <100	1	69.94	1	65.90
100 to <250	0	0	1	207.05
250 to <500	0	0	0	0
500 to <1000	0	0	0	0
>1,000	0	0	0	0
Total	3383	218.65	8075	850.86

Table A17. Count and total area by patch size range, for shrubland in the Park-Manager-Selected AOA and Regional AOA, for 2011.

Patch Size Range, in km ²	2011 Park-Manager-Selected		2011 Regional	
	Count	Total Area (km ²)	Count	Total Area (km ²)
<1	7810	248.15	16548	501.56
1 to <5	49	95.53	98	193.45
5 to <10	7	50.33	16	115.89
10 to <25	8	122.90	12	188.41
25 to <50	1	27.16	1	39.54
50 to <100	0	0	0	0
100 to <250	0	0	2	234.68
250 to <500	0	0	0	0
500 to <1000	0	0	0	0
>1,000	0	0	0	0
Total	7875	544.07	16677	1273.55

Table A18. Area, percentage of AOA, and percentage of forest area by pattern density classification in the Park-Manager-Selected and Regional AOAs, for 2011.

Density Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of Forested Area	Percentage of AOA*	Area (km ²)	Percentage of Forested Area	Percentage of AOA*
Rare	103.32	6.38	5.10	277.90	8.40	6.06
Patchy	336.05	20.74	16.58	802.43	24.24	17.49
Transitional	232.96	14.38	11.49	496.33	15.00	10.82
Dominant	427.67	26.39	21.10	841.50	25.43	18.35
Interior	195.30	12.05	9.63	356.79	10.78	7.78
Intact	325.13	20.06	16.04	534.77	16.16	11.66
Total	1620.42	100.00	79.93	3309.72	100.00	72.16

Table A19. Area, percentage of AOA, and percentage of grassland area by pattern density classification in the Park-Manager-Selected and Regional AOAs, for 2011.

Density Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of Grassland Area	Percentage of AOA*	Area (km ²)	Percentage of Grassland Area	Percentage of AOA*
Rare	112.96	20.34	5.57	268.69	14.93	5.86
Patchy	218.00	39.25	10.75	591.95	32.88	12.91
Transitional	72.72	13.09	3.59	267.09	14.84	5.82
Dominant	77.68	13.99	3.83	369.63	20.53	8.06

Table A19 (continued). Area, percentage of AOA, and percentage of grassland area by pattern density classification in the Park-Manager-Selected and Regional AOA's, for 2011.

Density Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of Grassland Area	Percentage of AOA*	Area (km ²)	Percentage of Grassland Area	Percentage of AOA*
Interior	24.21	4.36	1.19	116.42	6.47	2.54
Intact	49.78	8.96	2.46	186.38	10.35	4.06
Total	555.36	100.00	27.39	1800.16	100.00	39.25

Table A20. Area, percentage of AOA, and percentage of shrubland area by pattern density classification in the Regional and Park-Manager-Selected AOA's for 2011.

Density Classification	2011 Park-Manager-Selected			2011 Regional		
	Area (km ²)	Percentage of Shrubland Area	Percentage of AOA*	Area (km ²)	Percentage of Shrubland Area	Percentage of AOA*
Rare	216.50	15.36	10.68	474.59	14.92	10.35
Patchy	589.65	41.82	29.08	1299.01	40.84	28.32
Transitional	267.83	19.00	13.21	581.88	18.30	12.69
Dominant	251.24	17.82	12.39	576.29	18.12	12.56
Interior	52.59	3.73	2.59	142.79	4.49	3.11
Intact	32.13	2.28	1.58	105.96	3.33	2.31
Total	1409.93	100.00	69.55	3180.52	100.00	69.34

Table A21. Area, percentage of total area, and percentage of census area by housing density class in the Regional AOA, for 1970–2010.

Regional Housing Density Classes	1970	1980	1990	2000	2010
Rural (<6 units/ km ²)	2502.77	2225.61	2074.3	2000.71	1919.78
Percentage of Total Area	54.56	48.52	45.22	43.62	41.85
Percentage of Census Area	88.57	78.76	73.41	70.77	67.87
Exurban (7–146 units/ km ²)	273.97	534.31	671.04	732.88	809.86
Percentage of Total Area	5.97	11.65	14.63	15.98	17.66
Percentage of Census Area	9.70	18.91	23.75	25.92	28.63
Suburban (146–1235 units/ km ²)	19.11	35.14	48.9	60.93	66.26
Percentage of Total Area	0.42	0.77	1.07	1.33	1.44
Percentage of Census Area	0.68	1.24	1.73	2.16	2.34
Urban (>1235 units/ km ²)	0.41	1.20	2.02	3.04	3.35
Percentage of Total Area	0.01	0.03	0.04	0.07	0.07
Percentage of Census Area	0.01	0.04	0.07	0.11	0.12
Commercial/Industrial	29.49	29.49	29.49	29.49	29.49
Percentage of Total Area	0.64	0.64	0.64	0.64	0.64
Percentage of Census Area	1.04	1.04	1.04	1.04	1.04
Urban-Regional Park	0.03	0.03	0.03	0.03	0.03
Percentage of Total Area	<0.01	<0.01	<0.01	<0.01	<0.01
Percentage of Census Area	<0.01	<0.01	<0.01	<0.01	<0.01
Total Area	4586.775	4586.77	4586.77	4586.77	4586.77
Total Census Area	2825.78	2825.78	2825.78	2827.08	2828.77

Table A22. Area, percentage of total area, and percentage of census area by housing density class in the Park-Manager-Selected AOA for 1970–2010.

Park-Manager-Selected Housing Density Classes	1970	1980	1990	2000	2010
Rural (<6 units/ km ²)	972.55	874.5	837.57	827.08	801.70
Percentage of Total Area	47.97	43.14	41.31	40.80	39.54
Percentage of Census Area	82.04	73.77	70.66	69.72	67.53
Exurban (7-146 units/ km ²)	168.97	253.02	278.04	280.64	301.96
Percentage of Total Area	8.33	12.48	13.71	13.84	14.89
Percentage of Census Area	14.25	21.34	23.45	23.66	25.44

Table A22 (continued). Area, percentage of total area, and percentage of census area by housing density class in the Park-Manager-Selected AOA for 1970–2010.

Park-Manager-Selected Housing Density Classes	1970	1980	1990	2000	2010
Suburban (146- 1235 units/ km ²)	17.16	30.43	41.59	49.38	54.03
Percentage of Total Area	0.85	1.50	2.05	2.44	2.67
Percentage of Census Area	1.45	2.57	3.51	4.16	4.55
Urban (>1235 units/ km ²)	0.37	1.10	1.85	2.81	3.06
Percentage of Total Area	0.02	0.05	0.09	0.14	0.15
Percentage of Census Area	0.03	0.09	0.16	0.24	0.26
Commercial/Industrial	26.35	26.35	26.35	26.35	26.35
Percentage of Total Area	1.30	1.30	1.30	1.30	1.30
Percentage of Census Area	2.22	2.22	2.22	2.22	2.22
Urban-Regional Park	0.03	0.03	0.03	0.03	0.03
Percentage of Total Area	<0.01	<0.01	<0.01	<0.01	<0.01
Percentage of Census Area	<0.01	<0.01	<0.01	<0.01	<0.01
Total Area	2027.336	2027.34	2027.34	2027.34	2027.34
Total Census Area	1185.43	1185.43	1185.43	1186.29	1187.13

Table A23. Census blocks, area, total population, and population density in the Regional AOA for 1990, 2000, and 2010.

Measure	1990	2000	2010	1990–2000 Percentage Change	2000–2010 Percentage Change
Number of Census Blocks	122	108	132	–	–
Corrected Area (km ²)	4202.63	4205.37	4207.12	–	–
Population	136,965	153,459	167,252	12.04	8.99
Population Density (population/km ²)	32.59	36.49	39.75	11.97	8.94

Table A24. Census blocks, area, total population, and population density in the Park-Manager-Selected AOA for 1990, 2000, and 2010.

Measure	1990	2000	2010	1990–2000 Percentage Change	2000–2010 Percentage Change
Number of Census Blocks	98	87	108	–	–
Corrected Area (km ²)	1758.15	1757.83	1758.35	–	–
Population	99,894.16	112,108.47	125,776.56	12.23	12.19
Population Density (population/km ²)	56.82	63.78	71.53	12.25	12.16

Table A25. Road length and density in the Regional AOA for 2010 and 2015. Summaries were calculated from US Census Bureau TIGER data.

Measure	2010	2015
Length (km)	7378.79	7242.01
Density (km/km ²)	1.61	1.58

Table A26. Road length and density in the Park-Manager-Selected AOA for 2010 and 2015. Summaries were calculated from US Census Bureau TIGER data.

Measure	2010	2015
Length (km)	3727.50	3664.08
Density (km/km ²)	1.84	1.81

Table A27. Road length and density in the Park AOA for 2016. Summaries were calculated from Whiskeytown data.

Measure	2016
Length (km)	211.80
Density (km/km ²)	1.24

Table A28. Count and total area by roadless area size category in the Regional AOA, using 2010 and 2015 US Census Bureau TIGER data.

Regardless Area Categories	2011		2015	
	Count	Total Area (km ²)	Count	Total Area (km ²)
0-10 km ²	992	656.76	983	649.29
10-50 km ²	52	1086.69	51	1044.05
50-100 km ²	1	88.99	2	147.64
> 100 km ²	7	1329.38	7	1336.38

Table A29. Count and total area by roadless area size category in the Park-Manager-Selected AOA, using 2010 and 2015 US Census Bureau TIGER data.

Regardless Area Categories	2011		2015	
	Count	Total Area (km ²)	Count	Total Area (km ²)
0-10 km ²	415	274.04	407	264.19
10-50 km ²	22	479.24	21	434.05
50-100 km ²	1	79.98	2	136.15
> 100 km ²	4	602.04	4	605.96

Table A30. Count and total area by roadless area size category in the Park AOA, using 2016 Whiskeytown road data.

Regardless Area Categories	2016	
	Count	Total Area (km ²)
0-10 km ²	47	42.69
10-50 km ²	0	0
50-100 km ²	1	75.57
>100 km ²	0	0

Table A31. Area and percentage of AOA affected by fire related disturbances in the Regional AOA, for 1999–2012.

Year	Wildfire		Prescribed		Wildland	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
1999	268.91	5.86	0.46	0.01	0.30	0.01
2001	1.37	0.03	–	–	–	–
2000	14.24	0.31	0.02	<0.01	–	–
2002	6.62	0.14	1.33	0.03	0.11	<0.01
2003	0.85	0.02	4.87	0.11	–	–
2004	98.92	2.16	0.43	0.01	3.83	0.08
2005	7.81	0.17	4.18	0.09	–	–
2006	14.45	0.31	–	–	0.17	0.00
2007	1.71	0.04	1.78	0.04	–	–
2008	366.13	7.98	1.20	0.03	–	–
2009	4.92	0.11	0.38	0.01	–	–
2010	0.03	<0.01	0.96	0.02	–	–
2011	–	–	3.58	0.08	–	–
2012	12.80	0.28	1.41	0.03	0.02	<0.01
Total	798.75	–	20.59	–	4.43	–

Table A32. Area and percentage of AOA affected by logging related disturbances in the Regional AOA for 1999–2012.

Year	Clearcut		Harvest		Thinning		Mastication		Other Mechanical	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
1999	—	—	1.15	0.03	<0.01	<0.01	—	—	—	—
2000	—	—	0.97	0.02	—	—	—	—	—	—
2001	3.16	0.07	4.13	0.09	1.04	0.02	—	—	—	—
2002	1.28	0.03	1.68	0.04	0.82	0.02	—	—	—	—
2003	0.03	<0.01	0.32	0.01	0.34	0.01	1.64	0.04	1.16	0.03
2004	0.91	0.02	3.83	0.08	4.19	0.09	3.05	0.07	0.67	0.01
2005	3.71	0.08	8.00	0.17	4.57	0.10	1.18	0.03	1.18	0.03
2006	7.49	0.16	7.57	0.16	1.34	0.03	0.06	<0.01	2.46	0.05
2007	0.14	<0.01	2.46	0.05	0.13	<0.01	1.80	0.04	1.06	0.02
2008	4.79	0.10	4.40	0.10	4.89	0.11	—	—	0.60	0.01
2009	0.34	0.01	25.77	0.56	0.02	<0.01	0.52	0.01	1.22	0.03
2010	—	—	—	—	0.11	<0.01	—	—	0.46	0.01
2011	15.28	0.33	7.53	0.16	2.06	0.04	0.02	<0.01	1.47	0.03
2012	1.45	0.03	0.03	<0.01	6.74	0.15	0.48	0.01	1.19	0.03
Total	38.58	—	67.82	—	26.26		8.75	—	11.46	—

Table A33. Area and percentage of AOA affected by disturbances other than fire and logging in the Regional AOA for 1999–2012.

Year	Disease		Biological		Unknown	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
1999	–	–	–	–	6.05	0.13
2000	–	–	–	–	5.08	0.11
2001	–	–	–	–	2.83	0.06
2002	–	–	–	–	2.70	0.06
2003	–	–	–	–	2.46	0.05
2004	–	–	–	–	–	–
2005	–	–	–	–	10.16	0.22
2006	–	–	–	–	1.71	0.04
2007	0.27	0.01	–	–	4.14	0.09
2008	–	–	–	–	6.17	0.13
2009	–	–	–	–	3.33	0.07
2010	–	–	–	–	12.51	0.27
2011	–	–	0.42	0.01	6.06	0.13
2012	–	–	–	–	5.72	0.12
Total	0.27	–	0.42	–	68.9	–

Table A34. Area and percentage of AOA affected by fire related disturbances in the Park-Manager-Selected AOA for 1999–2012.

Year	Wildfire		Prescribed		Wildland	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
2001	12.54	0.62	0.02	<0.01	–	–
2002	5.91	0.29	0.18	0.01	0.11	0.01
2003	0.06	<0.01	2.92	0.14	–	–
2004	65.57	3.23	0.43	0.02	3.83	0.19
2005	4.49	0.22	4.18	0.21	–	–
2006	3.68	0.18	–	–	0.06	0.00
2007	0.95	0.05	1.50	0.07	–	–
2008	253.28	12.49	0.06	<0.01	–	–

Table A34 (continued). Area and percentage of AOA affected by fire related disturbances in the Park-Manager-Selected AOA for 1999–2012.

Year	Wildfire		Prescribed		Wildland	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
2009	4.92	0.24	0.38	0.02	–	–
2010	–	–	0.96	0.05	–	–
2011	–	–	2.60	0.13	–	–
2012	5.40	0.27	1.56	0.08	0.02	0.00
Total	378.71	–	15.24	–	4.32	–

Table A35. Area and percentage of AOA affected by logging related disturbances in the Park-Manager-Selected AOA for 1999–2012.

Year	Clearcut		Harvest		Thinning		Mastication		Other Mechanical	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
1999	–	–	0.77	0.04	0.00	0.00	–	–	–	–
2000	–	–	0.97	0.05	–	–	–	–	–	–
2001	0.67	0.03	0.25	0.01	–	–	–	–	–	–
2002	0.13	0.01	1.31	0.06	–	–	–	–	–	–
2003	0.03	0.00	0.09	0.00	0.73	0.04	0.04	0.00	0.38	0.02
2004	–	–	2.69	0.13	2.83	0.14	1.73	0.09	0.66	0.03
2005	1.56	0.08	4.88	0.24	3.41	0.17	1.18	0.06	1.14	0.06
2006	3.14	0.15	1.88	0.09	0.45	0.02	0.06	0.00	1.67	0.08
2007	0.14	0.01	1.78	0.09	0.13	0.01	1.80	0.09	0.55	0.03
2008	–	–	0.59	0.03	–	–	–	–	0.59	0.03
2009	0.33	0.02	25.63	1.26	0.01	0.00	0.06	0.00	1.23	0.06
2010	–	–	–	–	0.11	0.01	–	–	0.46	0.02
2011	10.53	0.52	6.45	0.32	1.46	0.07	0.02	0.00	1.72	0.09
2012	–	–	–	–	–	–	0.02	0.00	1.09	0.05
Total	16.52	–	47.28	–	9.12	–	4.90	–	9.49	–

Table A36. Area and percentage of AOA affected by disturbances other than fire and logging in the Park-Manager-Selected AOA for 1999–2012.

Year	Regional		Unknown	
	Area (km ²)	% of AOA*	Area (km ²)	% of AOA*
1999	–	–	2.73	0.13
2000	–	–	3.78	0.19
2001	–	–	0.69	0.03
2002	–	–	1.03	0.05
2003	–	–	0.54	0.03
2004	–	–	–	–
2005	–	–	3.95	0.19
2006	–	–	0.72	0.04
2007	–	–	2.11	0.10
2008	–	–	3.58	0.18
2009	–	–	0.64	0.03
2010	–	–	7.19	0.35
2011	0.34	0.02	4.26	0.21
2012	–	–	3.77	0.19
Total	0.34	–	35.00	–

Table A37. Area and percentage of AOA affected by fire related disturbances in the Park AOA for 1999–2012.

Year	Wildfire		Prescribed		Wildland	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
1999	–	–	0.46	0.27	0.30	0.17
2000	–	–	–	–	–	–
2001	3.26	1.91	0.01	0.01	–	–
2002	5.75	3.37	0.18	0.10	0.07	0.04
2003	–	–	2.92	1.71	–	–
2004	8.39	4.92	0.43	0.25	3.77	2.21
2005	3.36	1.97	4.04	2.37	–	–
2006	–	–	–	–	–	–

Table A37 (continued). Area and percentage of AOA affected by fire related disturbances in the Park AOA for 1999–2012.

Year	Wildfire		Prescribed		Wildland	
	Area (km ²)	% of AOA	Area (km ²)	% of AOA	Area (km ²)	% of AOA
2007	–	–	–	–	–	–
2008	41.54	24.36	–	–	–	–
2009	–	–	–	–	–	–
2010	–	–	–	–	–	–
2011	–	–	0.72	0.42	–	–
2012	–	–	0.13	0.08	–	–
Total	62.30	–	8.89	–	4.14	–

Table A38. Area and percentage of AOA affected by disturbances other than fire and logging in the Park AOA for 1999–2012.

Year	Harvest		Thinnings	
	Area (km ²)	% of AOA*	Area (km ²)	% of AOA*
1999	–	–	–	–
2000	–	–	–	–
2001	–	–	–	–
2002	–	–	–	–
2003	–	–	–	–
2004	–	–	–	–
2005	<0.01	<0.01	–	–
2006	–	–	–	–
2007	–	–	–	–
2008	–	–	–	–
2009	0.01	<0.01	–	–
2010	–	–	0.10	0.06
2011	<0.01	<0.01	–	–
2012	–	–	–	–
Total	<0.03	–	0.10	–

Table A39. Area and percentage of AOA affected by disturbances other than fire in the Park AOA for 1999–2012.

Year	Unknown	
	Area (km ²)	% of AOA*
1999	0.51	0.30
2000	0.07	0.04
2001	<0.01	<0.01
2002	0.01	<0.01
2003	<0.01	<0.01
2004	–	–
2005	0.02	0.01
2006	–	–
2007	–	–
2008	0.08	0.04
2009	–	–
2010	–	–
2011	–	–
2012	–	–
Total	0.68	–

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