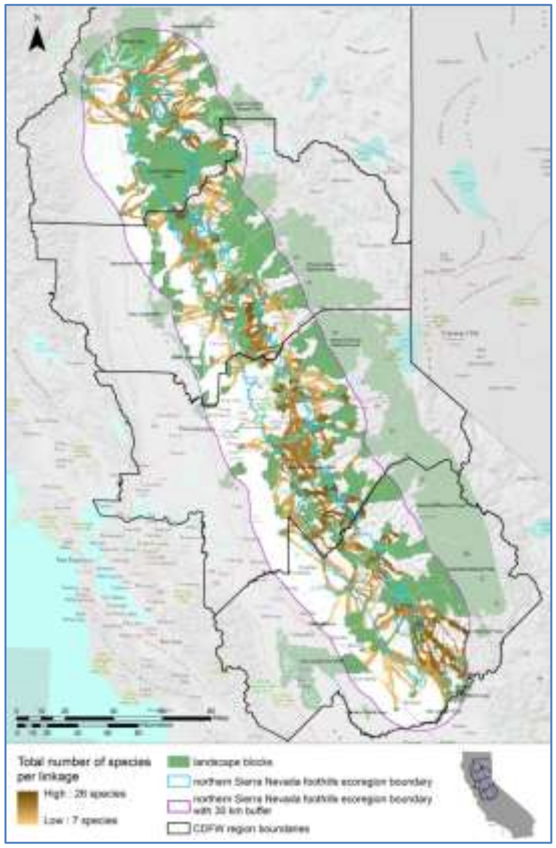
Wildlife connectivity across the northern Sierra Nevada foothills



Technical report to the California Wildlife Conservation Board on the northern Sierra Nevada foothills fine-scale connectivity analysis

Prepared by:
Crystal M. Krause
Melanie Gogol-Prokurat
Simon Bisrat

California Department of Fish and Wildlife
Biogeographic Data Branch
Conservation Analysis Unit

January 2015

Acknowledgments

We would like to thank the California Wildlife Conservation Board for funding; Canh Nguyen, David Wright, Stacy Heminway, Chris Curlis and Sara Holm of CDFW Region 2 and Sara Morrison and Charlotte Peters of CDFW Region 4 for providing species data and support; Levi Souza, Matt Meshiry, Marc Kenyon, Mary Sommer, Laura Patterson, Carie Battisone, Neil Clipperton, Caitlin Bean, and David Wright for reviewing our habitat models; Dan Applebee for input on parcel size in the urban mask; Dr. Lorraine Flint and Dr. Alan Flint of USGS for providing the downscaled climate data; Dr. Robert Hijmans of UC Davis for his technical help related to the 'dismo' R package; Todd Keeler-Wolf, Diana Hickson and Rosie Yacoub for vegetation data and input on land facets; Brian Brost and Jeff Jenness for technical help related to the land facets analysis; all attendees of our April 5, 2013 Conservation Partners meeting who provided input on Landscape Blocks; regional land trusts and CDFW Lands staff who provided Conservation Easement data; and Sophie Klenner and Sandra Summers of CDFW BDB for technical assistance. Images in this report are from the US Fish and Wildlife Service National Digital Library.

How to use this report

The purpose of this project was to build onto the statewide California Essential Habitat Connectivity (CEHC) work as recommended in the CEHC project report. Our project objectives were to take a fine-scale look at connectivity within the NSNF and between the NSNF and adjacent lands in the Central Valley and Sierra Nevada, using species-specific data to model connections between blocks of protected lands. The models identified important core habitat areas for focal species as well as least-cost-path wildlife corridors between these core areas. We also identified riparian and land facets corridors. Land facet corridors are areas of land with uniform topographic and geologic features that will interact with future climate to support species and species movement under future climate conditions. Our connectivity analysis incorporated species-specific habitat data, patch size and dispersal ability of 30 focal species to identify the best corridors for species to find habitat and move across the landscape. This analysis can help us to better understand what barriers to species movement are present in the landscape, where they are located, and will help us devise a strategy to maximize landscape connectivity for conservation and land use planning.

Species-specific information and analysis; results maps (habitat suitability models, core habitat patches, and least-cost corridors); and discussion of habitat suitability, connectivity and barriers for each species can be found in the focal species section of the report. Final maps for wildlife linkages, riparian corridors and land facet corridors can be found in the Results section of the report. The corresponding GIS shapefiles of the project results can be viewed online or downloaded from the CDFW BIOS website [http://www.dfg.ca.gov/biogeodata/bios/]. A summary of findings about connectivity and barriers throughout the foothills, as well as an analysis comparing the methodologies used in this project, can be found in the Discussion section of the report. Additional information on conducting a fine-scale habitat connectivity analysis can be found in our Guidance Document (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=93018).

Contents

1 Executive Summary

Habitat loss and fragmentation are major threats to the biodiversity of California as urban development and infrastructure transforms the landscape to meet the growing human population needs of the state (FRAP 2010). These threats can impact wildlife in multiple ways including barriers to movement and gene flow, increased risk of mortality due to vehicular collisions or human activities, and increased risk of exposure to disease (Ordenana et al. 2010). Habitat fragmentation caused by urbanization can lead to the decline or even the local extinction of species with large home ranges, such as mountain lions, bobcats and coyotes (Crooks 2002). Connected landscapes are preferable to fragmented landscapes for maintaining wildlife populations and ecological processes (Beier and Noss 1998) and building a connected landscape through the identification and conservation of corridors may offer help in mitigating the impacts of habitat loss and fragmentation.

Wildlife connectivity and linkages are a key component of wildlife conservation. In 2008, the California Legislature added language (AB 2785) to the Fish and Game Code recognizing the importance of connectivity to the long-term viability of the state's biodiversity (FGC 1930c). Both the Fish and Game Code (FGC 1930d) and the State Wildlife Action Plan have identified fragmentation and lack of habitat connectivity as key stressors to California's wildlife. Furthermore, the 2009 California Climate Adaptation Strategy recognized that corridors that provide paths for movement between currently occupied habitat and habitat that will be suitable in the future under different climate scenarios are essential to facilitate the persistence of species in the face of climate change. The California Department of Fish and Wildlife (Department) has been charged with investigating, studying, and identifying those areas in the state that are most essential to habitat corridors and linkages (FGC 1930.5). The Wildlife Conservation Board funded this study, which was conducted in the Conservation Analysis Unit of the Department's Biogeographic Data Branch, to conduct a regional connectivity analysis using fine-scale vegetation data developed by the Department's Vegetation Classification and Mapping Program.

The northern Sierra Nevada foothills (NSNF) ecoregion was selected as the study area for this analysis because it represents an important movement corridor between the low elevations of the Central Valley and the mountains of the Sierra Nevada, and because of the availability of a fine-scale vegetation map with accurate land cover data for modeling. The NSNF encompasses a narrow band (~32 km wide) of low to mid-elevation habitat approximately 450 km long that runs from Shasta County to Madera County. Many species find habitat throughout the northern Sierra Nevada foothills (600+ species; CWHR 2008). The foothills provide key habitat areas for species such as mule deer that migrate seasonally between high elevations in the Sierras during the summer and lower elevations in the foothills during the winter. The oak woodlands in the foothills also provide an important food source (acorns) for many species ranging from birds, to rodents, to large mammals (CWHR 2008). We identified 238 "landscape blocks" in the study area, representing protected lands that provide core habitat areas for wildlife. The purpose of the study was to model linkages – the best habitats for wildlife movement - between these landscape blocks.

We used species-specific data in conjunction with fine-scale vegetation (habitat) data to develop habitat suitability models for 30 focal species representative of the wildlife of the study region, selected based on their sensitivity to habitat fragmentation. Habitat suitability model results were reviewed by Department species experts, and the results used to identify core habitat patches for each species. For nine of the most motile species ("passage species"), the data were then used to identify least-cost corridors linking core habitat patches between landscape blocks. For 21 "corridor dwellers", species that live in the corridor and may take several generations to move through a corridor, a patch analysis was used to identify "stepping stones" of habitat patches within dispersal distance of the species connecting landscape blocks. The habitat corridors and habitat patches for the 30 focal species were combined to build a linkage that would provide for wildlife movement between each pair of neighboring landscape blocks.

Our analysis identified 246 wildlife linkages connecting 198 landscape blocks, with each linkage providing habitat for at least seven and up to 26 focal species (mean=16). The total linkage area is 1,143,695.9 ha. Of this area, 13.9% are lands under permanent conservation protection (USGS GAP status 1, 2, or 3 or in conservation easement). The linkages range in elevation from 7 m to 2,379 m and cover many different vegetation types. For the total area of linkages, 27.4% were in oak woodland, 24.6% in grassland, 5.5% in chaparral, and 10.6% in mixed conifer.

In some parts of the foothills, there were many overlapping linkages identified. This indicates that natural habitat in these areas is still relatively continuous and species have many options when moving across the landscape. For conservation, this means that there are likely a variety of opportunities to maintain connectivity for wildlife. In other areas there was only a single corridor or no corridor identified between two neighboring blocks. This indicates that wildlife movement between the blocks may be impeded by barriers and opportunities for maintaining connectivity are likely limited. Restoration or other mitigation efforts may be required to achieve adequate connectivity between habitat patches when little natural connectivity is remaining. Linkages that cross highways and major roads may likewise require special attention to ensure that the linkage adequately functions to provide wildlife connectivity.

In addition to the wildlife linkages, we identified 280 riparian corridors throughout the study region. Riparian corridors are important for wildlife movement because they provide continuous swaths of cover, food, and water, and they may also provide the only remaining natural swaths of habitat through highly modified landscapes. The riparian corridors provided many east-west corridors, which complemented the wildlife linkages, the majority of which had a north-south orientation. Riparian corridors offer an important tool for conservation planning, representing areas that are important for wildlife and serve multiple ecological functions, although our analysis found they provide species habitat and connectivity for only a subset of species in the study area.

To address species movement under climate change, we also identified land facet corridors. Land facets are areas of the landscape with uniform topographic and geologic characteristics that can be used to predict areas of habitat that are expected to be suitable in future climates without relying on models of future temperature and precipitation, which have high uncertainty. We used a land facet analysis to identify 169 land facet corridors representing canyons, slopes, and ridges, connecting 94 landscape blocks.

A connected landscape is crucial for maintaining ecological processes and healthy wildlife populations over time. There are many factors that influence wildlife movement including ecological attributes of the landscape, physical attributes of the landscape, and species behavior (Van Vuren 1998). A natural landscape without man-made barriers provides the greatest freedom for species to maintain natural movement patterns and for ecological processes to continue unhindered, although physical barriers to movement also exist in natural landscapes. A connectivity analysis can help us to better understand what barriers are present in the landscape, where they are located, how they may affect species movement, and can help us devise a strategy to maximize landscape connectivity in the future. The habitat patch analysis provides a way to see where the important core habitat areas for each species are located in the landscape and how they are juxtaposed with conservation lands, as well as to identify isolated habitat patches or habitat patches likely to become isolated in the future. The least-cost path analysis provides a robust methodology for identifying how the core habitat areas within conservation lands can best be linked together to support wildlife populations and wildlife movement over time. The maps of core habitat patches and wildlife linkages, supplemented by maps of riparian corridors and land facets, can be used to address species-specific conservation needs as well as overall habitat connectivity in conservation planning.

Connectivity and Barriers in the Foothills

For the purposes of analysis, discussion, and representation on maps, we split the study area into four subsections from north to south based on the Department's Region boundaries and county boundaries.

The **NSNF Region 1 subsection** is the northernmost subsection of the study area and includes parts of Shasta, Tehama, and Plumas counties. The southwestern side of this study subsection has some agricultural and urban development from Corning to Red Bluff, in some places extending to the boundary of the foothills ecoregion. The northwestern side of this subsection includes the City of Redding and Lake Shasta, which pose barriers to movement to the north and west. Within the foothills and on the eastern side of the study area, natural habitat is fairly continuous and generally well-connected, although some naturally isolated habitat patches were found in the east. Much of the foothills area in Tehama County is covered by a single landscape block (Chilcoot Wilderness Area Block) which includes various conservation lands including the Tehama Wildlife Area, the Nature Conservancy's Dye Creek Preserve and Vina Plains Preserve, and parts of the Lassen National Forest. Several large landscape blocks are found on the east side of the study area including Lassen National Forest and Lassen National Park. Linkages providing habitat for the largest number of focal species are located on the eastern edge of the foothills between Lassen National Forest and the south fork of Battle Creek, as well as southeast of the town of Shingleton near the town of Manton. Wildlife linkages on the western side of this study subsection have the greatest number of major road crossings, including Highway 5, and State Routes 299 and 273.

The **NSNF Region 2 North subsection** ranges from Butte County south through Nevada, Yuba, and Sutter counties. The western side of this study subsection has extensive agricultural and urban development, in most places extending to the boundary of the foothills ecoregion, including the cities of Marysville, Yuba City, Gridley, Oroville, and Chico. Habitat patches on the western side of the study area were found to have limited connectivity with the foothills. The City of Oroville and adjacent Lake Oroville are significant barriers to wildlife movement that span the entire width of the foothills in Butte County. In addition, the cities of Grass Valley, Nevada City, and Paradise pose barriers to movement in the central and eastern foothills. On the eastern side of the study area, natural habitat is fairly continuous and generally well-connected, although extensive logging in the forests on the east side of the study area may impact habitat suitability. Several large landscape blocks are found on the east side of the study area including the Plumas and Tahoe National Forests. Wildlife linkages providing habitat for the largest number of focal species are located through the central foothills: between Big Chico Creek and the Plumas National Forest, and near the Spenceville Wildlife Area and Bear River. Wildlife linkages with the greatest number of road crossings are on the western side of the study area between the Sutter Buttes and Spenceville Wildlife Area, crossed by highways 99, 70, and 20; and a connection on the eastern side of the foothills near the town of Grass Valley that is crossed by highways 49, 20, and 174.

The **NSNF Region 2 South subsection** ranges from Placer County south through Calaveras County. The western side of the study subsection is highly developed, including the cities of Sacramento and Elk Grove, and adjacent agricultural areas. Habitat patches on the western side of the study area were found to have limited connectivity with the foothills. The cities of Sacramento, Roseville, Lincoln, Auburn, and surrounding cities along Highway I-80 represent a significant barrier to wildlife movement that extends from west to east across almost the entire study area. Outside of these urban areas, natural habitat within the foothills and on the eastern side of the study area is fairly continuous and generally well-connected. Several large landscape blocks are found on the east side of the study area including the El Dorado and Tahoe National Forests. Wildlife linkages providing habitat for the largest number of focal species are located through the central foothills, including from the Cosumnes River south to the Mokelumne River; between the Mokelumne River and the Antelope Valley Wildlife Area; and south from the Mokelumne River and Bear Mountains to New Melones Lake. Wildlife linkages with the greatest number of major road crossings are those to the north, east, and south of the greater Sacramento area, with road crossings of highways 80, 50, 49, 16, 88, 104, and 124.

The **NSNF Region 4 subsection** ranges from Tuolumne County south through Madera County, and into a small area of northern Fresno County. The cities of Merced and Madera are located in the western and southern side of this study subsection, and intensive agricultural development is found along the entire western side of the study area, in some places extending almost to the boundary of the foothills ecoregion. The western part of the foothills in this subregion has little land under conservation protection; very few landscape blocks were identified in the western foothills, and no landscape blocks were identified on the southern end of the foothills. Several landscape blocks were identified in the Central Valley on the western side of the study area, although habitat patches in these blocks had limited connectivity with the foothills due to surrounding agricultural and urban development. Natural habitat within the foothills and on the eastern side of the study area is fairly continuous and generally well-connected. Several large landscape blocks are found on the east side of the study area including Yosemite National Park and Stanislaus National Forest. Linkages providing habitat for the largest number of focal species are located in the eastern and southeastern part of the subregion as well as in the central foothills between New Melones Lake, the Red Hills, and the Stanislaus National Forest. Linkages with the greatest number of major road crossings include one on the western side that crosses highways 4, 120, and 132, and several on the southern end of the study area crossing highways 99, 49 and 41.

2 Introduction

2.1 Importance of wildlife connectivity

Habitat loss and fragmentation are major threats to the biodiversity of California as urban development and related infrastructure projects transform the landscape to meet the growing human population needs of the state (FRAP 2010). These threats can impact wildlife in multiple ways by creating barriers to movement and gene flow, and by increasing the risk of mortality due to vehicular collisions, human activities, and exposure to disease (Ordenana et al. 2010). Habitat fragmentation caused by urbanization can lead to the decline or even local extinction of many area sensitive species such as mountain lion, bobcats and coyotes (Crooks 2002). A connected landscape is preferable to a fragmented landscape (Beier and Noss 1998) and identifying and building a connected landscape with corridors may offer help in mitigating the impacts of habitat loss and fragmentation.

2.2 Importance to the Department

Wildlife connectivity and linkages are a key component of wildlife conservation. In 2008, the California Legislature added language (AB 2785) to the Fish and Game Code recognizing the importance of connectivity to the long-term viability of the state's biodiversity (FGC 1930c). Both the Fish and Game Code (FGC 1930d) and the State Wildlife Action Plan have identified fragmentation and lack of habitat connectivity as key stressors to California's wildlife. Furthermore, the 2009 California Climate Adaptation Strategy recognized that corridors that provide paths for movement between currently occupied habitat and habitat that will be suitable in the future under different climate scenarios are essential to facilitate the persistence of species in the face of climate change. The Department of Fish and Game (Department) has been charged with investigating, studying, and identifying those areas in the state that are most essential to habitat corridors and linkages (FGC 1930.5). The Legislature specified its intent that the Wildlife Conservation Board (WCB) should use various funds to work with the Department and support these efforts (FGC 1930.5b).

2.3 What's been done

Several projects have examined wildlife connectivity throughout California at different scales, from statewide projects such as the California Essential Habitat Connectivity Project and Missing Linkages Project, to regional projects such as the California Desert Connectivity Project, to local species-specific projects such as the work done by Epps et al. (2007) on desert bighorn sheep.

The *Missing Linkages: Restoring Connectivity to the California Landscape* project was developed by a group of land managers, planners, scientist and conservationist from across the state that met to identify the location of and threats to wildlife movement corridors in California at a conference in 2000 (Penrod et al. 2001). This project identified 232 linkages based on expert knowledge.

A decade later, the *California Essential Habitat Connectivity Project* (CEHC), commissioned by the California Department of Transportation (CalTrans) and California Department of Fish and Wildlife (Department), identified connectivity areas statewide based on the best available GIS data. This analysis provides a broad overview of remaining wildland areas (natural landscape blocks) and connectivity pathways between these blocks (essential connectivity areas), using transparent and repeatable modeling methods. The project was developed in collaboration with over 200 partners across the state. The final connectivity map depicts 850 Natural Landscape Blocks and 192 Essential Connectivity Areas based on the concept of ecological integrity (Davis et al. 2003, Davis et al. 2006, Spencer et al. 2010). The CEHC map products are broad scale and do not incorporate species-specific connectivity needs. The CEHC report recommends fine-scale regional analysis to identify important connectivity areas for use in local and regional conservation planning.

Examples of regional studies of connectivity in California include the South Coast Missing Linkages project, the California Desert Connectivity Project, Critical Linkages: Bay Area and Beyond, a San Joaquin Valley linkages project, and desert bighorn sheep fine-scale connectivity models. The South Coast Missing Linkages project has identified habitat and connectivity needs for southern California (Beier et al. 2006). This fine scale project encompassed 11 focal species based linkage designs (Penrod et al. 2003, Luke et al. 2004, Penrod et al. 2004a, Penrod et al. 2004b, Penrod et al. 2005b, a, c, d, 2006a, b, Penrod et al. 2006c, Penrod et al. 2008a, Penrod et al. 2008b, Penrod et al. 2012). The California Desert Connectivity Project evaluated connectivity needs across the deserts of California and developed fine scale focal species based linkage designs (Penrod et al. 2012). This project selected 44 focal species and identified 22 linkage planning areas (Penrod et al. 2012). The Critical Linkages: Bay Area and Beyond project identified areas vital for connectivity for the nine county Bay Area. This project selected 66 focal species and identified 14 linkage planning areas (Penrod et al. 2013). Huber et al. (2012) developed fine scale focal species based linkages in the San Joaquin Valley for four focal species. Epps et al. (2007) developed desert bighorn sheep fine scale connectivity models with genetic data for portions of the Mojave and Sonoran Desert ecoregions. These are just some examples of connectivity work across the state. One of the ecoregions not covered by previous projects is the Sierra Nevada foothills.

2.4 Importance of wildlife connectivity in the foothills

The northern Sierra Nevada foothills (NSNF) ecoregion encompasses a narrow band (~32 km wide) of low to mid-elevation habitat approximately 443 km long that runs from Shasta County to Madera County. The foothills ecoregion is oriented approximately parallel to the coastline, ~200 km inland, just east of the Central Valley and west of the Sierra Nevada mountains. The foothills ecoregion represents an important movement corridor between the low elevations of the Central Valley and the mountains of the Sierra Nevada. The foothills also provide key habitat areas for species such as mule deer that migrate seasonally between high elevations in the Sierra Nevada mountains during the summer and lower elevations in the foothills during the winter. The oak woodlands in the foothills also provide an important food source (acorns) for many species ranging from birds, to rodents, to large mammals (CWHR 2008). More than 600 species find habitat throughout the northern Sierra Nevada foothills (CWHR 2008), including 37 species that are State or Federally-listed as Endangered, Threatened or Rare (CNDDB 2014, Appendix A).

2.5 Goals and Objectives

The purpose of this project was to build onto the statewide California Essential Habitat Connectivity (CEHC) work as recommended in the CEHC project report. Our project objectives were to take a fine-scale look at connectivity within the NSNF and between the NSNF and adjacent lands in the Central Valley and Sierra Nevada, using species-specific data to model connections between blocks of protected lands. The models identified important core habitat areas for focal species as well as least-cost-path wildlife corridors between these core areas. We also identified riparian and land facets corridors. Land facet corridors are areas of land with uniform topographic and geologic features that will interact with future climate to support species and species movement under future climate conditions.

We followed these basic steps to accomplish the goals and objectives of the project:

1. Select focal species and lands to connect (landscape blocks).
2. Predict suitable habitat for each focal species using Maxent (statistical model) and BioView (expert opinion model).
3. Conduct literature review to identify habitat patch size, configuration and dispersal distance variables for each species and develop habitat patch analysis.
4. Perform corridor analysis to identify areas of high quality habitat that can function as connections between landscape blocks for passage species.
5. Perform a patch analysis to identify corridor needs for corridor dweller species.
6. Perform a linkage analysis that combines the results of the corridor and patch analysis to identify areas of connectivity for passage species and corridor dwellers.
7. Identify riparian corridors that connect landscape blocks.
8. Perform land facet corridor analysis to identify areas of topographic similarity that may provide resilience to climate change.
9. Compare the three corridor types to evaluate best habitat coverage and movement areas.

3 Methods

3.1 Study Area

The study area encompasses the NSNF and a 30 km buffer around the ecoregion (Figure 1). The 30 km buffer was included to incorporate movement between the low elevation Central Valley and higher elevation of the Sierra Nevada mountains. The elevation for the study area ranges from 0 - 3,133 m, with a mean elevation of 545 m. The majority of vegetation in the study area is a matrix of grassland (20.7%), mixed conifer (15.8%) oak woodland (15.5 %) and agriculture (16.3%; source vege15). Of the 1,032,353 total ha in the NSNF ecoregion, 171,182 ha (16 %) are in permanent protection, owned and managed by the US Bureau of Land Management, US Forest Service, California Department of Fish and Wildlife, and 55 other federal, state and local agencies; counties; cities; conservation NGOs and land trusts. An additional 30,000+ ha (3%) are under conservation easement (as mapped in the National Conservation Easement Database).

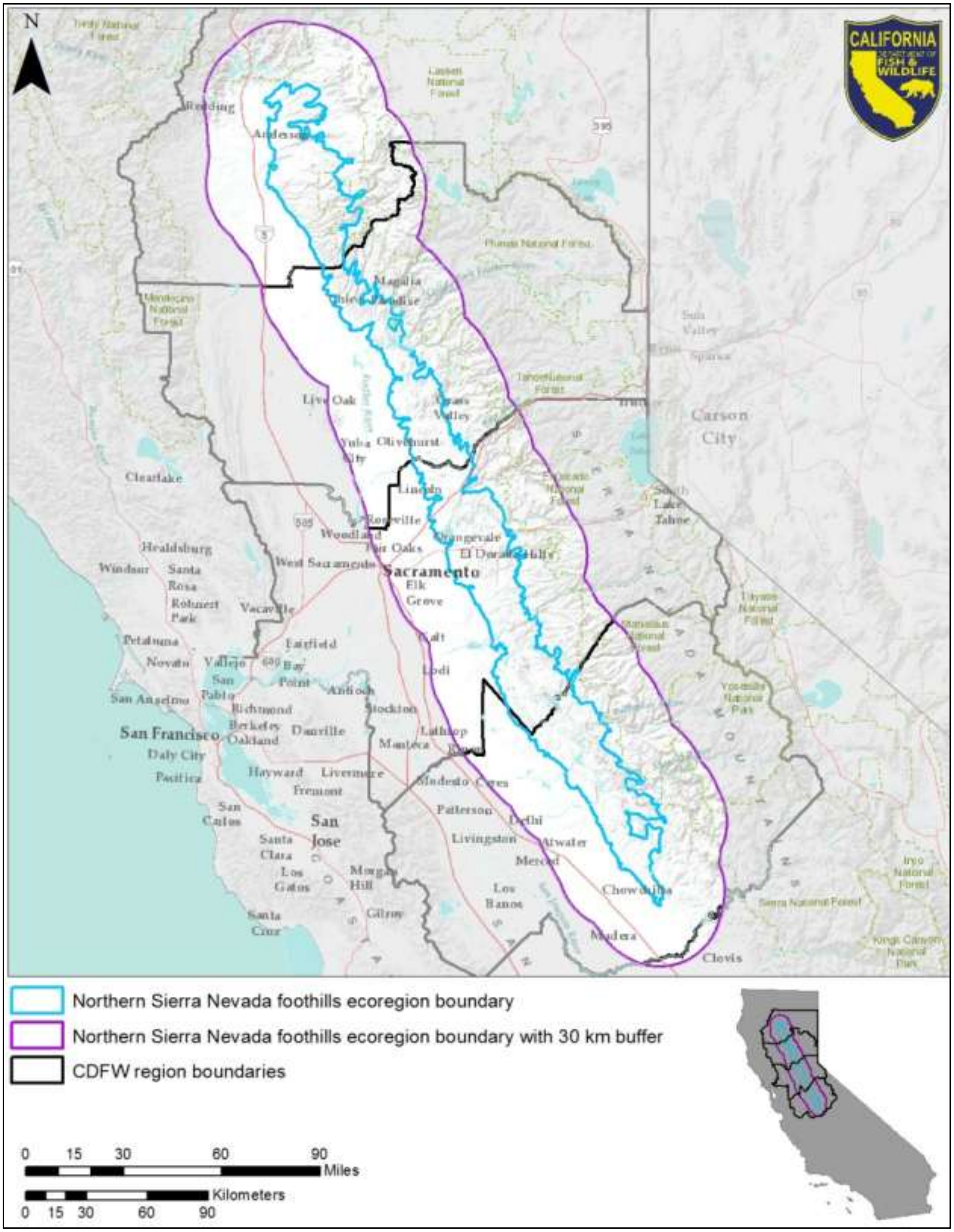


Figure 1: Map of the northern Sierra Nevada foothills ecoregion boundary with 30 km buffer.

3.2 Focal Species

Focal species habitat data provide the underpinning of each linkage. Beier et al. (2009) suggests selecting a diverse group of focal species to design linkages. We selected our focal species from a list of terrestrial vertebrate species known to occur in our study area, based on the California Wildlife Habitat Relationships (CWHR) system (http://www.dfg.ca.gov/biogeodata/cwhr/).

We developed selection criteria and ranked each species according to the criteria. Next we evaluated the species to identify those that would use the corridor to move through (**passage species**) and that will live in the corridor (**corridor dwellers**). Corridor dwellers are those species that will live in the corridor and that may take multiple generations to move through the corridor.

The criteria for selecting focal species were based on movement and habitat requirements: we prioritized species with movement as a key component of their life history as well as species whose habitat and movement needs encompassed those of multiple species (Table 1). Species that met the selection criteria were then stratified across taxonomic groups to represent the diversity of habitat requirements and movement needs across the ecoregion. We solicited expert opinion from the Department's species experts and region office biologists to select a final list of 9 passage species and 21 corridor dwellers for analysis (Table 2). This collaboration with species experts was helpful in several ways: species experts helped to identify data sources and biogeographic information such as home range, patch size and dispersal distance for each focal species, and later also reviewed habitat and connectivity models.

Table 1. Focal species selection criteria and ranking.

1	Area-sensitive: species that occur in lower density but require large areas
2	Barrier-sensitive: species that are specifically sensitive to road development
3	Umbrella: species that are representative of a trophic group/guild, related species, rare species, mobility class, key ecological process or other collection of species.
4	Dispersal-limited: species that require seasonal migration (fine scale movement)
5	Habitat specialist: species that are highly sensitive to habitat loss or fragmentation
6	Listed status: species of greater conservation need based on conservation status rankings

Table 2. List of focal species used in the northern Sierra Nevada foothills fine-scale wildlife connectivity analysis.

Taxonomic group	Scientific Name	Common Name	Corridor dweller	Passage species
amphibian	*Aneides lugubris*	ARBOREAL SALAMANDER	X	
	Rana boylii	FOOTHILL YELLOW-LEGGED FROG	X	
	Hydromantes brunus	LIMESTONE SALAMANDER	X	
bat	*Antrozous pallidus*	PALLID BAT	X	
bird	*Melanerpes formicivorus*	ACORN WOODPECKER	X	
	Callipepla californica	CALIFORNIA QUAIL	X	
	Toxostoma redivivum	CALIFORNIA THRASHER	X	
	Accipiter cooperii	COOPER'S HAWK	X	
	Chondestes grammacus	LARK SPARROW	X	
	Oreotyx pictus	MOUNTAIN QUAIL	X	
	Glaucidium gnoma	NORTHERN PYGMY OWL	X	
	Pipilo maculatus	SPOTTED TOWHEE	X	
	Aix sponsa	WOOD DUCK	X	
	Pica nuttalli	YELLOW BILLED MAGPIE	X	
carnivore	*Ursus americanus*	BLACK BEAR		X
	Lynx rufus	BOBCAT		X
	Urocyon cinereoargenteus	GRAY FOX		X
	Puma concolor	MOUNTAIN LION		X
ungulate	*Odocoileus hemionus*	MULE DEER		X
lagomorph	*Lepus californicus*	BLACK-TAILED JACKRABBIT		X
reptile	*Phrynosoma coronatum*	COAST HORNED LIZARD	X	
	Pituophis catenifer	GOPHER SNAKE	X	
	Coluber constrictor	RACER	X	
	Elgaria multicarinata	SOUTHERN ALLIGATOR LIZARD	X	
	Actinemys marmorata	WESTERN POND TURTLE		X
rodent	*Spermophilus beecheyi*	CALIFORNIA GROUND SQUIRREL	X	
	Dipodomys californicus	CALIFORNIA KANGAROO RAT	X	
	Neotoma fuscipes	DUSKY-FOOTED WOODRAT		X
	Dipodomys heermanni	HEERMANN'S KANGAROO RAT	X	
	Sciurus griseus	WESTERN GRAY SQUIRREL		X

3.3 Species location data and Environmental Variables

Species location data were compiled from multiple sources: two online museum collections, Global Biodiversity information facility (GBIF; http://www.gbif.org) and Arctos (http://arctos.database.museum/home.cfm); and the Department datasets from regional offices, the Wildlife Branch and the California Natural Diversity Database (CNDDB). Additional bird data were provided by Point Blue Conservation Science, formerly PRBO. The location points were inspected for consistency with known species range and duplicate points were removed. The species location data were split 70/30 for running and testing model performance within Maxent.

Climate variables, elevation, distance to water, and vegetation were used as environmental variables (Table 3). We conducted a correlation analysis using the 'Band Collection Statistics' tool in ArcGIS and removed one of the highly correlated variables in situations where two predictors are highly correlated ($r>0.7$).

Climate Variables: PRISM (Parameter-elevation Regression on Independent Slopes Model) monthly climate normals for the period between 1981 and 2010 were used as the source of the climate variables. The 800 meter climate normals were downscaled to 270 meter by Alan Flint and Lorrie Flint of USGS. Nineteen bioclimatic variables were then generated out of the monthly climate normals using an AML code written by Dr. Robert Hijmans of UC Davis. We used only 11 bioclimatic variables out of the 19 bioclimatic variables based on correlation analysis and also based on other ecological and biological considerations (Table 2). After an exploratory analysis of models using different combinations of climate variables, and in an effort to limit the number of variables used to reduce model overfitting, four bioclim variables were chosen for use in the final models: annual mean temperature (bio1), temperature seasonality (bio4), annual precipitation (bio12) and precipitation seasonality (bio15).

Elevation: Elevation data at 270 m spatial resolution was obtained from Alan and Lorrie Flint of USGS. The original source of the data is 30 m NED (National Elevation Dataset) of USGS which is a seamless elevation dataset for the conterminous United States. We considered slope and aspect as additional topography derived variables, but determined they were not ecologically important drivers of the distributions of our focal species. For this reason, we did not include slope or aspect.

Distance to Water: The distance to water layer represented distance to the nearest mapped perennial water source including perennial streams, rivers, lakes, and springs. It was generated using multiple datasets that map the location of perennial water sources including the NHD (National Hydrography Dataset) for state of California, wetland, riparian, lake and spring data as primary sources. First, a perennial streams dataset was created (see Appendix B for a full description of the processing steps). The resulting perennial streams dataset was then merged with the wetland, riparian, and springs data extracted from the project vegetation map, the Department's Vegetation Classification and Mapping program's (VegCAMP) vegetation maps, and the Department's Lake GIS dataset. The final merged dataset represented perennial water sources in California. This datasets was then used to create a raster measuring the distance of each cell to the nearest perennial water source.

<u>Vegetation</u>: We used the northern Sierra Nevada Foothills (Menke et al. 2011) and Eastern Central Valley (CDFW and GIC 2013) fine-scale vegetation maps developed by VegCamp. For areas outside the foothills and eastern central valley we used land cover data compiled by California Department of Forestry and Fire Protection (CDF) Fire and Resource Assessment Program (FRAP) in 2006, representing data for the period between 1997 and 2002. FRAP compiled the "best available" land cover data into a single data layer, to support the various analyses required for the Forest and Rangeland Assessment, a legislatively mandated function. The land cover data provided a crosswalk to 13 and 65 CWHR (California Wildlife Habitat Relationships) habitat types. Because the total extent of each class influences the output in Maxent when using a categorical variable, we reclassified the vegetation layer to 15 classes with relatively even area across the landscape for use in the model. We also generated vegetation layers for percent conifer habitat, percent grassland, percent hardwood habitat, and percent shrubland per grid cell to represent vegetation as continuous variables. To do this we reclassified the 30 m land cover data into the four 4 vegetation classes and calculated the percent of each land cover class per final 270 m grid cell.

<u>Geology</u>: We used the 2010 edition of the Geologic Map of California geodatabase (Jennings et al. 2010) to select import geologic features for Limestone salamander. We selected Mesozoic Metalvolcanic Rocks, Mesozoic Plutonic Rocks, Mesozoic Sedimentary and Metasedimentary Rocks, and Paleozoic Sedimentary and Metasedimentary Rocks features because they represented the species location points.

Table 1. Name and description of the environmental variables used in the habitat suitability models.

Variable	Variable Name	Description and Biological Interpretation
bio01	Annual Mean Temperature	The annual mean temperature approximates the total energy inputs for an ecosystem
bio02	Annual Mean Diurnal Range	The mean of the monthly temperature ranges (monthly maximum minus monthly minimum). It can help provide information pertaining to the relevance of temperature fluctuations for species distribution
bio03	Isothermality	It quantifies how large the day-to-night temperature oscillates relative to other summer-to-winter (annual) oscillations. A species distribution may be influenced by larger or smaller temperature fluctuations within a month relative to the year and this predictor is useful for ascertaining such information
bio04	Temperature Seasonality	The amount of temperature variation over a given year based on standard deviation of monthly temperature averages. It is a measure of temperature change over the course of the year. The larger the standard deviation the greater variability of temperature
bio05	Maximum Temperature of Warmest Month	This is calculated by selecting the maximum temperature value across all months within a given year. It ascertains whether the species distributions are affected by warm temperature anomalies throughout the year.
bio06	Minimum Temperature of Coldest Month	This is calculated by selecting the minimum temperature value across all months within a given year. It ascertains whether the species distributions are affected by cold temperature anomalies throughout the year
bio12	Annual Precipitation	This is the sum of all total monthly precipitation. It helps to ascertain the importance of water availability (total water inputs) to species distributions
bio15	Precipitation Seasonality (CV)	This is the measure of the variation in monthly precipitation totals over the course of the year. It is calculated as the ratio of the standard deviation of the monthly total precipitation to the mean monthly total precipitation and expressed as a percentage. Can be useful if the species distribution is affected by precipitation variability.
bio16	Precipitation of Wettest Quarter	This quarterly index approximates total precipitation that prevails during the wettest quarter. It can be useful for examining how total precipitation during the wettest three months may affect species seasonal distributions
bio17	Precipitation of Driest Quarter	This quarterly index approximates total precipitation that prevails during the driest quarter. It can be useful for examining how total precipitation during the driest three months may affect species seasonal distributions
bio18	Precipitation of Warmest Quarter	This quarterly index approximates total precipitation that prevails during the warmest quarter. It can be useful for examining how total precipitation during the warmest three months may affect species seasonal distributions
distTowater	Distance to water	It measures distance to the nearest water point (streams, rivers, lakes, wetland or riparian area)
Elev	Elevation	Elevation is the height point of a location relative to sea level
pctconifer	Percent conifer	Percent of pixel mapped as conifer
pctgrass	Percent grass	Percent of pixel mapped as grassland
pcthrdwd	Percent hardwood	Percent of pixel mapped as hardwood
pctshrub	Percent shrub	Percent of pixel mapped as shrubland
pctwetland	Percent “wet”	Percent of pixel mapped as habitat type with surface water present
Vege13	Vegetation type	Vegetation type represented with 13 CWHR categories
Vege15	Vegetation type	Vegetation type represented with 15 classes
Vege65	Vegetation type	Vegetation type represented with 65 CWHR categories
Geology	Geologic features	Geologic features selected for Limestone Salamander

3.4 Landscape Blocks

Landscape blocks are the areas the corridors will connect. Landscape blocks can be defined many different ways depending on the goals of the study. Beier et al. (2011) suggest seven ways to define landscape blocks: expert opinion mapped areas; areas of high ecological integrity; all or a subset of protected areas; areas that meet quantitative conservation targets using optimization algorithms; previously developed conservation maps; maps of modeled or know habitat for a suite of species; or preliminary natural landscape blocks modified by highways or other linear barriers. For the NSNF we based our landscape blocks on protected lands managed primarily for biodiversity conservation, including 1) USGS GAP Analysis conservation status designations GAP 1 and 2 (see Table 4 for GAP status definitions); 2) lands under conservation easement; and 3) GAP 3 lands that intersect with CEHC natural landscape blocks (blocks of land >2,000 acres with high ecological integrity). This represented protected lands with high habitat value that were expected to maintain this habitat value and conservation status in the foreseeable future. After compiling a draft map of landscape blocks based on our criteria, we held a Conservation Partners meeting on April 5, 2013 to acquire input from stakeholders and local experts including local, regional, and state government land management agencies, land trusts, non-profits, and ecologists and species experts. We split our landscape blocks by major rivers and roads to identify barriers within blocks.

Table 4. Definition of lands selected for landscape blocks.

Acronym	Definition of land status
GAP 1*	An area of permanent protection from conversion of natural land cover and a mandated management plan to maintain a natural state and disturbance events.
GAP 2*	An area of permanent protection from conversion of natural land cover and a mandated management plan to maintain a primarily natural state, but may receive uses that degrade the quality of existing natural communities, including suppression of natural disturbance.
GAP 3*	Multiple use public lands. An area of permanent protection from conversion of natural land cover for most of the area, but subject to extractive uses of either a broad, low intensity type, i.e. logging, or localized intense type, i.e. mining; protection to federally listed species throughout the area.
NCED	Privately owned conservation easement lands from the National Conservation Easement Database, which represents approximately 60% of the conservation easements in California. Data are from land trusts and public agencies. Conservation easements are legal agreements voluntarily entered into between landowners and conservation entities (agencies or land trusts) for the express purpose of protecting certain societal values such as open space or vital wildlife habitats.

*USGS GAP Analysis program protected areas conservation status code (http://gapanalysis.usgs.gov/padus/data/)

3.5 Habitat models

For each focal species we developed two types of models to predict suitable habitat across the study area: a statistical Maxent model and an expert opinion vegetation model (CWHR BioView). We selected

Maxent (Phillips et al. 2006) because it is one of the well-performing species distribution models available and it is also able to handle presence-only species data. We used species location data, background points, and the environmental variables to predict habitat suitability. Background points (10,000 for each species) were randomly generated using the 'randomPoints' function in 'dismo' package (Hijmans et al. 2011). Due to the relatively large number of sample points for four bird species (acorn woodpecker, California quail, mountain quail, and spotted towhee), we used 30,000 background points for these four species. We implemented Maxent in R using the 'dismo' package (Hijmans et al. 2011). The models were developed at 270 m spatial resolution with five replications using 10-fold cross-validation as a method of sample evaluation. Cross-validation involves the partitioning of the sample data into *n* subsets and fitting the models to *n-1* subsets and testing the model on the one subset that is not used in fitting the model.

We developed several models for each species using different sets of environmental variables, or scenarios, as described below. The different scenarios were used to compare models with and without bioclimatic variables, and with categorical vs. continuous vegetation variables. Species experts reviewed the models for each species and provided input on variable selection and how well the model output matched the known distribution of the species. Based on expert input, additional variables, such as geology and percent wetland, were added for several species.

Scenario5 (categorical vegetation with climate): Four bioclimatic variables, elevation, distance to water, and vegetation were used to predict habitat suitability. The vegetation layer in this scenario was defined by 15 vegetation classes. The climatic variables were: bio01 (Annual Mean Temperature), bio04 (Temperature Seasonality), bio12 (Annual Precipitation), and bio15 (Precipitation Seasonality).

Scenario6 (categorical vegetation without climate): Elevation, distance to water, and vegetation were used to predict habitat suitability. The vegetation layer in this scenario was defined by 15 vegetation classes. All climate variables were excluded in order to see the effects of the remaining variables on model outputs.

Scenario7 (continuous vegetation without climate): Elevation, distance to water, and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by four continuous vegetation datasets (percent conifer, percent grassland, percent hardwood, and percent shrubs). All climate variables were excluded in order to see the effects of the remaining variables on model outputs.

Scenario9 (continuous vegetation with climate): Four bioclimatic variables, elevation, distance to water, and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by four continuous vegetation datasets (percent conifer, percent grassland, percent hardwood, and percent shrubs). The four climatic variables were: bio01 (Annual Mean Temperature), bio04 (Temperature Seasonality), bio12 (Annual Precipitation), and bio15 (Precipitation Seasonality).

Scenario5w (categorical vegetation, with wetland, with climate): Four bioclimatic variables, elevation, percent "wet", and vegetation were used to predict habitat suitability. Percent "wet" was added as an additional variable, created as a continuous grid to represent percent of the pixel where surface water would be present. The vegetation layer in this scenario was defined by 15 vegetation classes. The climatic variables were: bio01 (Annual Mean Temperature), bio04 (Temperature Seasonality), bio12 (Annual Precipitation), and bio15 (Precipitation Seasonality).

Scenario6w (categorical vegetation, with wetland, without climate): In this scenario, elevation, percent "wet", and vegetation were used to predict habitat suitability. Percent "wet" was added as an additional variable, created as a continuous grid to represent percent of the pixel where surface water would be present. The vegetation layer in this scenario was defined by 15 vegetation classes. All climate variables were excluded in order to see the effects of the remaining variables on model outputs.

Scenario7w (continuous vegetation, with wetland, without climate): Elevation and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by five continuous vegetation datasets (percent "wet", percent conifer, percent grassland, percent hardwood, and percent shrubs). All climate variables were excluded in order to see the effects of the remaining variables on model outputs.

Scenario9w (continuous vegetation, with wetland, with climate): Four bioclimatic variables, elevation, and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by five continuous vegetation datasets (percent "wet", percent conifer, percent grassland, percent hardwood, and percent shrubs). The four climatic variables were: bio01 (Annual Mean Temperature), bio04 (Temperature Seasonality), bio12 (Annual Precipitation), and bio15 (Precipitation Seasonality).

Scenario7g (continuous vegetation, with geology, without climate): In this scenario, elevation, distance to water, geology, and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by four continuous vegetation datasets (percent conifer, percent grassland, percent hardwood, and percent shrubs). All climate variables were excluded in order to see the effects of the remaining variables on model outputs.

Scenario9g (continuous vegetation, with geology, with climate): In this scenario, four bioclimatic variables, elevation, distance to water, geology, and vegetation were used to predict habitat suitability. The vegetation data in this scenario was represented by four continuous vegetation datasets (percent conifer, percent grassland, percent hardwood, and percent shrubs). The four climatic variables were: bio01 (Annual Mean Temperature), bio04 (Temperature Seasonality), bio12 (Annual Precipitation), and bio15 (Precipitation Seasonality).

3.6 Model evaluation, threshold selection and data normalization

We evaluated model performance in R using the model evaluation metric AUC (area under the curve) using the 'PresenceAbsence' package in R (Freeman and Moisen 2008). For this evaluation method, AUC has been changed to accommodate for presence only data by using presence versus random rather than presence and absence (Phillips et al. 2006). Traditionally the Receiver Operating Characteristic (ROC) curve was used to evaluate the accuracy of the model and each variable's predictive power (Hanley and McNeil 1982). The ROC curve represents the relationship between the percentage of presences correctly predicted (sensitivity) and 1 minus the percentage of the absences correctly predicted (specificity). The area under the curve (AUC) measures the ability of the model to classify correctly a species as present or absent. AUC values can be interpreted as the probability that, when a site with the species present and a site with the species absent are drawn at random, the former will have a higher predicted value than the latter. For use with presence only data the AUC measures presence versus random background. A SDM can then make predictions for both a sample of presence and background points and a sample of background pixels (background pixels chosen uniformly at random; Phillips et al. 2006). Although the use of AUC test statistic has received criticism in recent years (Lobo et al. 2008), it is still viewed as an important metric when evaluating predictive performance (Elith and Graham 2009, Franklin 2009).

The 'PresenceAbsence' package in R (Freeman and Moisen 2008) also computes threshold values using several accuracy metrics to translate predicted probability maps into binary suitable and unsuitable habitats (Table 5). The species location points used in this project have two caveats: (i) they are presence only (with no species absence points available) and (ii) the samples are compiled from different data sources making it difficult to know the true observed prevalence (see for a detailed information on accuracy metrics Fielding and Bell 1997). For these reasons, we excluded threshold calculation methods that relied mainly on observed prevalence and sensitivity (which measures the proportion of observed absences predicted as true absences) and we selected the method known by the name 'MeanProb' which is a threshold set based on the mean predicted probability of species occurrences (Method 7 in Table 5).

The Maxent output are raster as multiband 'tif' format with one band for each replication. We averaged the five replicated maps and created a mean map for each species. We then used the threshold value to exclude areas with low probability and then normalized the data to range from 0-100. We then classified the raster into three bins of suitability, low suitability values of the threshold-50, medium suitability values of 51-75 and high suitability values of 76-100.

Table 5. Methods used in 'PresenceAbsence' package to calculate threshold values (from (Freeman and Moisen 2008).

	Methods	Description
1	Sens=Spec	Threshold where sensitivity equals specificity. It is a threshold where positive observations are just as likely to be wrong as negative observations.
2	MaxSens+Spec	Threshold that maximizes sum of sensitivity and specificity. This threshold minimizes the mean of error rates for positive and negative observations.
3	MaxKappa	Threshold that maximizes Kappa - where Kappa makes full use of the information in the confusion matrix to assess the improvement over chance prediction
4	MaxPCC	Threshold that maximizes PCC (percent correctly classified). This threshold becomes highly problematic for species with low prevalence.
5	PredPrev=Obs	Threshold where predicted prevalence equals observed prevalence. It uses the default prevalence in the data and it is not good if the observed prevalence is not truly known.
6	ObsPrev	Threshold set to observed prevalence. This threshold uses simply the observed prevalence in the data and it is not good if observed prevalence is not known *a priori*.
7	MeanProb	Threshold set to mean predicted probability. This method sets the threshold based on the mean probability of occurrence from the model results.
8	MinROCdist	Threshold where ROC curve makes closest approach to (0,1). This threshold minimizes the distance between ROC plot and the upper left corner of the unit square.
9	ReqSens	Highest threshold where sensitivity meets user defined requirement. The default is 0.85 which sets the model must miss no more than 15% of the points where the species is observed to be present.
10	ReqSpec	Lowest threshold where specificity meets user defined requirement. The default is 0.85 which sets the model miss no more than 15% of the points where the species is observed to be absent

3.7 Habitat patch analysis

The habitat patch analysis was used to identify all suitable habitat patches for each focal species across the study area, and all suitable habitat was denoted as a population patch, a breeding patch, or less than a patch. The SDM output, threshold value, species home range size and maximum dispersal distance are the basis for the patch analysis. Species home range size and dispersal distance were taken from the literature or expert opinion. Areas of contiguous suitable habitat larger than 25 times the recorded average home range size was recorded as a **population patch**. Population patches can sustain at least 50 individuals and may be capable of supporting the species for several decades. Areas of contiguous suitable habitat as least 2 times the minimum recorded home range but less than the population patch were identified as **breeding patches**. Breeding patches can support at least one breeding pair and are useful to the species if the patch can be linked via dispersal to other patches or core areas.

3.8 Least-cost corridor analysis

We followed the least-cost corridor techniques described by Beier et al. (2007) to identify a least-cost corridor, or the best potential route, for each species between each set of neighboring landscape blocks. The datasets needed for a least-cost corridor analysis are a resistance raster, core habitat patches, and landscape blocks. The resistance raster is the inverse of the SDM output, based on the assumption that cost for movement approximates the inverse of habitat suitability. We identified core habitat patches within the landscape blocks (population and breeding patches), and modeled the connections between these core habitat patches in neighboring blocks. In many landscape blocks there were multiple core habitat patches for a given species. We developed a least-cost corridor for each possible core habitat patch and used a rule-set to select the best individual species corridor between the two landscape blocks.

We developed the following rule-set to answer these questions:

1. Is the corridor continuous after urban mask is applied?
2. Does corridor provide sufficient habitat? Within species dispersal range?
3. Does expanding the corridor incorporate more habitat to meet species needs?

The least-cost corridor model identifies the least-cost corridor between any two patches, but does not evaluate whether all conditions to make the corridor functional are met, such as sufficient habitat patches within the dispersal distance of the species. It also does not evaluate whether there are barriers or other risks that could impede movement in the corridor. We evaluated each corridor to ensure it was ecologically functional.

We removed urban areas and areas of unsuitable/non-restorable habitat from the corridors and then inspected each corridor to make sure it was continuous. We examined the amount of predicted suitable habitat in each corridor, and measured the distance between habitat patches within each corridor to make sure they were within the maximum dispersal distance for that focal species. If the corridors did not meet these rules then habitat patches on the border of the corridor were added to meet the selection requirements, or the corridor was considered non-functional and deleted.

Once the final set of corridors was determined for each species, the corridors for the nine species were combined to generate a least-cost union. The least-cost union is a merge of the individual species corridors and identified the best swath of habitat available for focal species to move from one landscape block to another.

3.9 Linkages

The linkages incorporate data and information for all the focal species including corridor dwellers by building onto the least-cost union. From the least-cost union, habitat areas for corridor dwellers were added and redundant corridor were removed. First we identified all habitat patches within the corridor union and measured distance between each patch to make sure it was within the maximum dispersal distance for that corridor dweller; when needed, habitat near the corridor edge was added to meet the species dispersal needs. This analysis identified multiple swaths of habitat that species have the potential to reside in or move through. Redundant corridors were deleted to provide cleaner linkage areas.

To ensure that ecological processes were protected in each linkage, we imposed an average minimum width of 1 km for linkages. The minimum width of a linkage should be based on the needs of species that might inhabit the corridor rather than pass through, or may be based on home range size of the focal species (Beier et al. 2008). In areas where the linkage is less than the minimum width, Penrod et al. (2012) recommend adding natural habitats to either side of the union, and if no natural habitats are available, adding agricultural lands because they have the potential to be restored. Two km is suggested by several studies as a suitable minimum width (Beier et al. 2006, Brost 2010); however, due to the fine scale of our analysis, we imposed a 1 km minimum width.

3.10 Riparian corridors

We defined riparian corridors as the length of any stream with riparian vegetation mapped along at least part of the stream corridor. We used a perennial stream dataset derived from National Hydrography Dataset and Department Streams layer (see Appendix B) for state of California. We then extracted areas mapped as riparian vegetation in our project vegetation maps (2011 Northern Sierra Nevada Foothills and 2013 Eastern Central Valley VegCamp maps; FRAP multisource landcover for all other areas), and intersected these with the streams dataset to identify streams with mapped riparian vegetation. We added a 500 m buffer to each side of the stream to depict the riparian corridor.

3.11 Land facet corridors

We used land facets to model corridors that may be used for species movement with climate change. Land facets are formally defined as recurring landscape units with uniform topographic and soil attributes. Land facets focus on physical landscape units, such as slopes, ridges, and canyons, which will remain static over time even as the climate changes (Beier and Brost 2010). One of the methods often used to plan for the impending climate change effect on biodiversity is to design reserves and linkages using climate envelope models projected into future temperature and precipitation scenarios based on predicted emission scenarios. However, there is uncertainty associated with the emission scenarios, the future climate predictions (e.g., whether precipitation will increase or decrease), and species response to the change in climate, which taken together may result in poor model predictions of reserves and linkages that wildlife can use in the future (Beier and Brost 2010). Land facets are subject to less uncertainty by incorporating fewer variables with uncertainty.

The steps we implemented to design land facet corridors are described below. Unless otherwise stated, most of the tools we used in this analysis came from the ArcGIS toolbox and R package called 'Land Facet Corridor Designer' written by Jeff Jenness, Brian Brost, and Paul Beier (www.corridordesign.org) implemented in ArcGIS 10 (ESRI 2012) and R statistical software (R-project 2013).

3.11.1 Topographic Position Raster

The first step in land facet corridor analysis was to classify the study area into topographic classes, which were later further divided into land facets. We used the Topographic Position Index (TPI) tool to create a 3-class topographic position categorical raster that broadly classifies the landscape into canyons, ridges, and slopes. The slopes class included all the pixels that were not classified as either canyon or ridge, including flat areas. TPI was calculated as the difference between a cell's elevation value and the mean elevation of the neighborhood around the cell, with positive values indicating the cell was higher than the mean of its surrounding cells while negative values indicated the cell was lower than the mean of its surrounding cells. If the difference between a cell's elevation and the mean elevation of the neighborhood was greater than a user-defined elevation threshold, then the cell was classified as a ridge (if the cell was higher than the neighborhood) or a canyon (if the cell was lower than the neighborhood). All other cells were classified as slopes. TPI was highly influenced by the choice of the neighborhood size (i.e., the number of pixels surrounding the cell used in the neighborhood mean calculation) and the threshold elevation value selected to classify the landscape into the respective topographic classes. We tested several neighborhood sizes and threshold values, and based on visual inspection of TPI classes overlaid on aerial imagery in areas where we were familiar with the topography, we determined that a neighborhood size of 7 (210 meter radius) and threshold elevation value of 8 meters best represented the topography in the northern Sierra Nevada foothills.

3.11.2 Define and Map Land Facets

Each topographic class was then further classified into land facets. Land facets in canyon and ridge classes were defined based on elevation and slope (steepness as a continuous variable) whereas land facets in slopes class were defined using annual solar insolation in addition to slope and elevation. We used the 30 m resolution National Elevation Dataset (NED) digital elevation model as a source for the elevation data. We extracted slope angle in degrees from the 30 m resolution NED digital elevation model to characterize the steepness of the study area. We generated the insolation layer from the 30 m elevation data using the 'Area Solar Radiation' tool in ArcGIS 10. Annual solar insolation is defined as a measure of solar radiation energy received on a given surface area recorded during a given time. Units are in watt-hours per square meter (Wh/m^2). The tool calculated the sum of instantaneous radiation at half-hour intervals for one day per month over a calendar year as a function of latitude, aspect, slope and topographic shading.

3.11.3 Develop land facet corridors

We generated least-cost corridors for each land facet and each pair of landscape blocks. Just as core habitat patches within landscape blocks were connected for the wildlife species corridors, “termini”, or clusters of land facet raster cells, were connected between landscape blocks for land facets. The cumulative cost raster for each land facet and each pair of landscape blocks was used as the resistance surface to generate the least-cost corridors. To evaluate the land facet corridors, we calculated percent land facet density in each land facet corridor.

We used a similar rule set to the focal species corridors to select the final land facet corridors, using the following questions:

1. Is the corridor continuous after urban mask is applied?
2. Does corridor provide sufficient land facet pixels? Are the “pixel patches” within a 250 m dispersal distance?

3.12 Comparison of corridor types

We compared all three corridor types (focal species, riparian and land facet) with the predicted habitat of the nine passage species to see how well each corridor type captured wildlife habitat needs. We classified the nine passage species habitat into four categories: habitat values of zero, values from 1-50 were classed as low, 51-75 as medium and 76-100 as high. We then determined how much low, medium, and high suitability habitat was present in each corridor. We calculated what percentage of corridor represented habitat area, as well as how the total habitat area in each corridor compared to total habitat available.

We also compared the landscape blocks, linkages, riparian corridors and land facet corridors to other conservation project data to compare how well the fine-scale connectivity areas captured conservation priorities in the study area. We calculated area of each polygon in the comparison data, calculated areas of overlap with the landscape blocks and linkages, and derived statistics within GIS. We compared our data with CDFW Habitat Conservation and Natural Community Conservation Plans and USFWS designated Critical Habitat.

3.13 Attributes of landscape blocks, least-cost corridors and linkages

Each landscape block, least-cost corridor and linkage is represented as a polygon shapefile, which is a two-dimensional area in map space. Each shapefile has a list of attributes providing detailed information about the biological and physical traits of each polygon. Table 6 describes the attributes, statistics, characteristics and data sources used for calculation. We used ArcMap 10.1 (ESRI 2012) Zonal Statistics to generate summary statistics (min, mean, max); Calculate Geometry to calculate area and length; and Corridor Designer Evaluation Tools to calculate percent width. Table 7 provides a full list of attributes calculated for each corridor.

Table 2. Statistics used to describe landscape block, least-cost corridors and linkage polygons.

Statistic	Characteristics for which this statistic was used
Sum	Area of polygon
Proportion (%) of area in the polygon belonging to a certain classification (pixel)	Landcover classes (vege15) Land protection classes (GAP Status 1-4) Rarity-weighed richness hotspots Vernal pool Critical habitat BLM Area of Critical Environmental Concern Habitat patch Habitat suitability
Mean, range and standard deviation across all pixels for polygon	Elevation
Length	Length of least-cost path within corridor/linkage
Count and List	Ecoregions Ecoregions Subsections Counties Watersheds Major road crossings Critical habitat species CNDDB plant and animal
Density (km per km^2)	Major roads

Table 7. Attribute table fields for corridor GIS shapefiles.

	Descriptor	Data Source	Limitations	Acronym
Identifier	Unique number for LB, LCC or Linkage			Block_ID CorridorID LinkageID
	Name of landscape block (LB)			Block_Name
Landform	Mean, Min, Max and Standard Deviation of Elevation	Digital Elevation Model (270 m)		Elev_mean Elev_min Elev_max Elev_std
	Elevation range: difference between minimum and maximum elevation	Digital Elevation Model (270 m)		Elev_range
Polygon Area	Area of polygon in ac	Calculated in GIS		Area_ac
	Area of polygon in hectares	Calculated in GIS		Area_ha
Co rri do	Identifying numbers of LB			Block_A Block_B

	Descriptor	Data Source	Limitations	Acronym
	connected by the corridor or linkage			
	Length of corridor or linkage (m)	Measured in GIS, based on least-cost model		Length_m
Protections Status	Percent protected as GAP 1, 2, 3 or conservation easements	California Protected Areas Database (CPAD - www.calands.org), National Conservation Easement Database (NCED - http://www.conservationeasement.us/)		Pc_protect
	Percent protected as GAP 1, 2 or conservation easements			Pc_gap12e
	Percent protected as GAP 3			Pc_gap3
	Percent protected as GAP 4			Pc_gap4
	Percent private, unprotected status			Pc_priv
ACEC	Percent in BLM Areas of Critical Environmental Concern based on biological values	http://www.geocommunicator.gov/ ARCGIS/REST/services/ACEC/MapServer		
Habitat for listed species	Percent in USFWS designated Critical Habitat for federally listed species	GIS data provided by USFWS		Pc_crithab
	Number of species with Critical Habitat in the polygon			N_crithab
Species Diversity	Number of special status plant taxa occurring in polygon according to CNDDB and other CDFW datasets	http://www.dfg.ca.gov/ biogeodata/		N_CNDDB_p
	Number of special status animal taxa occurring in polygon according to CNDDB and other CDFW	http://www.dfg.ca.gov/ biogeodata/		N_CNDDB_a

	Descriptor	Data Source	Limitations	Acronym
	datasets			
	Percent in amphibian, reptile, mammal or plant rarity hotspot	http://www.dfg.ca.gov/ biogeodata/ace/		Pc_hotspot
Wetland	Percent in wetland or vernal pool	Carol W. Witham, Robert F. Holland and John Vollmar. 2013. 2005 Great Valley Vernal Pool Map, Plus Merced, Placer and Sacramento County Losses 2005-2010. Sacramento, CA. Report prepared for the U.S. Fish and Wildlife Service's and Bureau of Reclamation's CVPIA Habitat Restoration Program under Grant Agreement No. 80270-A-G509 with the USFWS.		Pc_wtvp
Roads	Number of times the polygon is intersected by major roads	ESRI Major Roads		Mjrd_cross
	Density of major roads (km/km^2)	ESRI Major Roads, Total length divided by polygon area		Mjrd_dens
Ecoregions	Number of USDA ecoregions that intersect the polygon	USDA Ecoregions California07_3		N_ecoreg
	List of ecoregions that intersect the polygon			ecoregs
	Number of USDA subsections that intersect the polygon			N_sebsect
	List of USDA subsections that intersect the polygon			subsect
Watersheds	Number of watersheds that intersect the polygon	HUName Calw221		N_HU
	List of watersheds that intersect the polygon			HU_name
Counties	Number of counties that intersect the polygon			N_counties

	Descriptor	Data Source	Limitations	Acronym
	List of counties that intersect the polygon			counties
Landcover	Percent classed as urban	vege_15 vegetation raster		Pc_urban
	Percent classed as chaparral			Pc_chprl
	Percent classed as conifer			Pc_cnfr
	Percent classed as coastal conifer			Pc_cconfr
	Percent classed as grassland			Pc_grslnd
	Percent classed as hardwood			Pc_hrdwd
	Percent classed as juniper			Pc_juniper
	Percent classed as mixed conifer			Pc_mx_confr
	Percent classed as oak woodland			Pc_oak
	Percent classed as orchard			Pc_orchard
	Percent classed as cropland			Pc_crop
	Percent classed as shrub			Pc_shrub
	Percent classed as water or wetland			Pc_wet

4 Results

4.1 Landscape Blocks

We identified 238 blocks of land to connect (Figure 2). The landscape blocks represent National Park Service, National Forest Service, Bureau of Land Management, Department of Defense, state, county and city lands and private lands under conservation easement. The landscape blocks represent 1,317,384.6 ha of land. Of which, 58% are protected lands with GAP 1, 2, 3 or conservation easement status. The landscape blocks cover a diverse group of vegetation and habitat with 22.5% in mixed conifer, 17.5% in grassland, 13.8% in oak woodland and 12.1% hardwood.

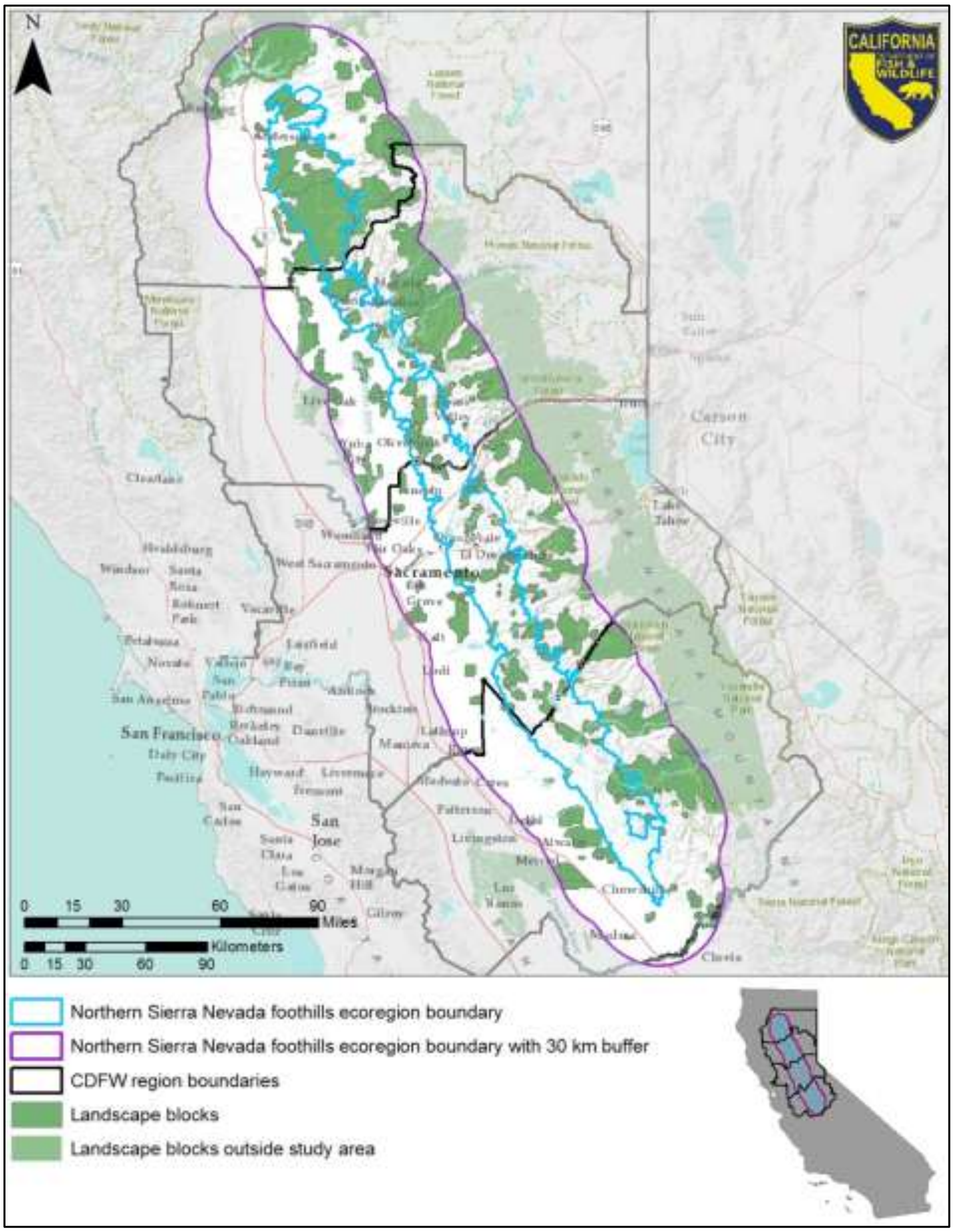


Figure 2. Map of landscape blocks, protected lands to connect with least-cost corridor analysis.

4.2 Habitat Suitability

Maxent models were chosen for 23 of the focal species, CWHR BioView for seven species. The Maxent models generally showed accuracy within the range of well-performing models (AUC > 0.75; Swets, 1988). AUC values for the BioView models are lower than the Maxent models because the BioView models are not based on species location data.

Predicted habitat varied across the study area according to each species life history and ecological needs. We predicted the smallest area of habitat for limestone salamander (41,079.2 ha), a highly specialized species known to occur in only one county in California. The largest area of habitat predicted was for California ground squirrel (4,352,334.1 ha), a wide-ranging, burrowing generalist. Detailed information for each focal species is located in the species account section of this report.

Table 8. Habitat model scenario selection, model performance measured by AUC, threshold value, and total predicted habitat area in hectares for focal species selected for connectivity analysis.

Common Name **Scientific Name**	**Selected habitat model**	**AUC**	**Threshold**	**Predicted habitat (ha)**
Acorn Woodpecker *Melanerpes formicivorus*	S7	0.75	0.29	3,359,596.5
Arboreal Salamander *Aneides lugubris*	S9	0.96	0.10	820,066.7
Black Bear *Ursus americanus*	S9	0.94	0.12	2,214,680.1
Black-tailed Jackrabbit *Lepus californicus*	S9	0.80	0.31	1,848,875.2
Bobcat *Lynx rufus*	Expert Opinion	0.56	-	4,235,118.2
California Ground Squirrel *Spermophilus beecheyi*	Expert Opinion	0.57	-	4,352,334.1
California Kangaroo Rat *Dipodomys californicus*	S5	0.96	0.10	896,035.8
California Quail *Callipepla californica*	S5	0.75	0.29	4,015,346.6
California Thrasher *Toxostoma redivivum*	S6	0.79	0.29	2,979,167.9
Coast Horned Lizard *Phrynosoma coronatum*	S6	0.81	0.28	1,464,320.4
Cooper's Hawk *Accipiter cooperii*	S6	0.73	0.34	3,325,902.1
Dusky-footed Woodrat *Neotoma fuscipes*	S9	0.88	0.21	4,032,886.3
Foothill Yellow-legged Frog *Rana boylii*	S7	0.95	0.16	2,084,386.0
Gopher Snake *Pituophis catenifer*	Expert Opinion	0.61	-	4,122,407.5

Common Name Scientific Name	Selected habitat model	AUC	Threshold	Predicted habitat (ha)
Gray Fox *Urocyon cinereoargenteus*	Expert Opinion	0.50	-	4,345,219.1
Heermann's Kangaroo Rat *Dipodomys heermanni*	S5	0.95	0.10	1,033,284.6
Lark Sparrow *Chondestes grammacus*	S7	0.81	0.32	2,899,211.1
Limestone Salamander *Hydromantes brunus*	S9_GEO	0.99	0.10	41,079.2
Mountain Lion *Puma concolor*	S5	0.91	0.16	2,864,773.2
Mountain Quail *Oreotyx pictus*	S7	0.78	0.23	1,616,980.3
Mule Deer *Odocoileus hemionus*	S6	0.75	0.34	3,529,387.9
Northern Pygmy Owl *Glaucidium gnoma*	S7	0.88	0.21	2,821,711.1
Pallid Bat *Antrozous pallidus*	Expert Opinion	0.56	-	4,348,900.5
Racer *Coluber constrictor*	Expert Opinion	0.60	-	3,716,274.3
Southern Alligator Lizard *Elgaria multicarinata*	S6	0.85	0.27	2,946,800.3
Spotted Towhee *Pipilo maculatus*	Expert Opinion	0.59	-	3,185,649.8
Western Gray Squirrel *Sciurus griseus*	S9	0.9	0.18	2,586,871.1
Western Pond Turtle *Actinemys marmorata*	S7	0.94	0.14	2,468,627.3
Wood Duck *Aix sponsa*	S6	0.95	0.17	1,054,068.4
Yellow-billed Magpie *Pica nuttalli*	S9	0.89	0.14	3,750,355.1

4.3 Corridor and Patch Analysis

We conducted least-cost corridor analysis for nine focal species (black bear, black-tailed jackrabbit, bobcat, dusky-footed woodrat, gray fox, mountain lion, mule deer, Western gray squirrel and Western pond turtle). The least-cost corridors were based on species specific habitat models and consisted of 47 black bear corridors, 105 black-tailed jackrabbit corridors, 81 bobcat corridors, 98 dusky-footed woodrat corridors, 85 gray fox corridors, 66 mountain lion corridors, 134 mule deer corridors, 99 Western gray squirrel corridors and 84 Western pond turtle corridors, with many species corridors overlapping. For many connections there was overlap in the corridors of at least two species despite diverse needs and the use of species specific data to build the habitat suitability models. The corridors capture each species habitat well, with the majority of corridors capturing at least 75% of the species habitat.

We conducted the patch analysis for all focal species. Limestone salamander was predicted to have the fewest habitat patches (5) across the study area. While black-tailed jackrabbit had the largest number of habitat patches, with 2,571. Sixty-nine percent of the total habitat area met the size requirements to be classified as habitat patches. Detailed information for each focal species is located in the species account section of this report.

4.4 Focal Species Accounts

The following pages provide detailed information about each focal species including life history information, model results, and final maps of habitat suitability models, patch analysis, and least cost corridors.

Life history information was taken from Department species accounts (Zeiner et al. 1990, CWHR 2008), and a literature search was conducted for each species. A list of focal species references is provided at the end of this section.

We split the study area into four sections for easier representation on the maps. The study area was split into four sections from north to south based on California Department Fish and Wildlife region boundaries (Regions 1, 2 and 4). Region 2 was further split into a northern and southern section by county boundary. A map of the final habitat suitability model used in the analysis is included for each focal species. For passage species, maps of the final least cost corridors for the species are included; for corridor dwellers, maps of the patch analysis showing population and breeding patches are included.

Acorn woodpecker (*Melanerpes formicivorus*)

Focal Species Selection: Acorn woodpeckers are barrier sensitive, oak woodland habitat specialists. They are considered an umbrella species for oak woodland habitats. They are threatened by the continued destruction of oaks in California (Verner and Boss 1980), and poor regeneration of oaks could be a major factor limiting acorn woodpeckers in the future (Koenig, Stacey et al. 1995). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the acorn woodpecker was included as a **corridor dweller**.

Status and Habitat: Acorn woodpeckers are common, yearlong residents below 2100 m elevation in hardwood and hardwood-conifer habitats (CWHR 2008). This woodpecker occurs throughout the foothills. The species requires low-density stands of large oaks with sparse canopy and snags, and is considered an indicator species of oak woodland health (CWHR 2008). Acorn woodpeckers seek water daily (CWHR 2008). Threats include the continued elimination, as well as poor regeneration, of oaks in California (Verner and Boss 1980).

Habitat Model: The final three habitat suitability models developed for acorn woodpecker were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 8159 location points to train each model, 2040 to test each model, and 17929 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Lives in cooperative social groups with varied territory sizes from 3.5 to 9 ha (MacRoberts and MacRobers 1976, Storer, Usinger et al. 2004). Minimum breeding patch size used was 3 ha; minimum population patch size was 100 ha.

Dispersal/Migration: Maximum dispersal distance of 8.6 km

Results and Discussion: The selected acorn woodpecker habitat suitability model was Maxent scenario 7. The model performed well with an AUC of 0.75. The mean probability threshold was 0.29, predicting 3,359,596.5 ha of suitable habitat. The patch analysis identified 669 breeding patches covering 18,304.8 ha and 270 population patches covering 2,373,754.6 ha. Two hundred thirty of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 84.7% of the total corridor area. Acorn woodpecker habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 47.8% of habitat area in corridors had high predicted suitability, 42.2% medium and 10% low.

Potential habitat for the acorn woodpecker is widespread throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with isolated patches on the western side near Chilcoot Wilderness Area (WA) and eastern side between Chilcoot WA and Lassen Volcanic National Park. The linkages capture most of the habitat patches in the north between Chilcoot WA and Shasta Lake.

Region 2 North: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Sacramento River NWR may become more isolated from the Chico block due to urbanization around the City of Chico. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Cosumnes River Ecological Reserve and Napa-Sonoma Marshes Wildlife Area are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

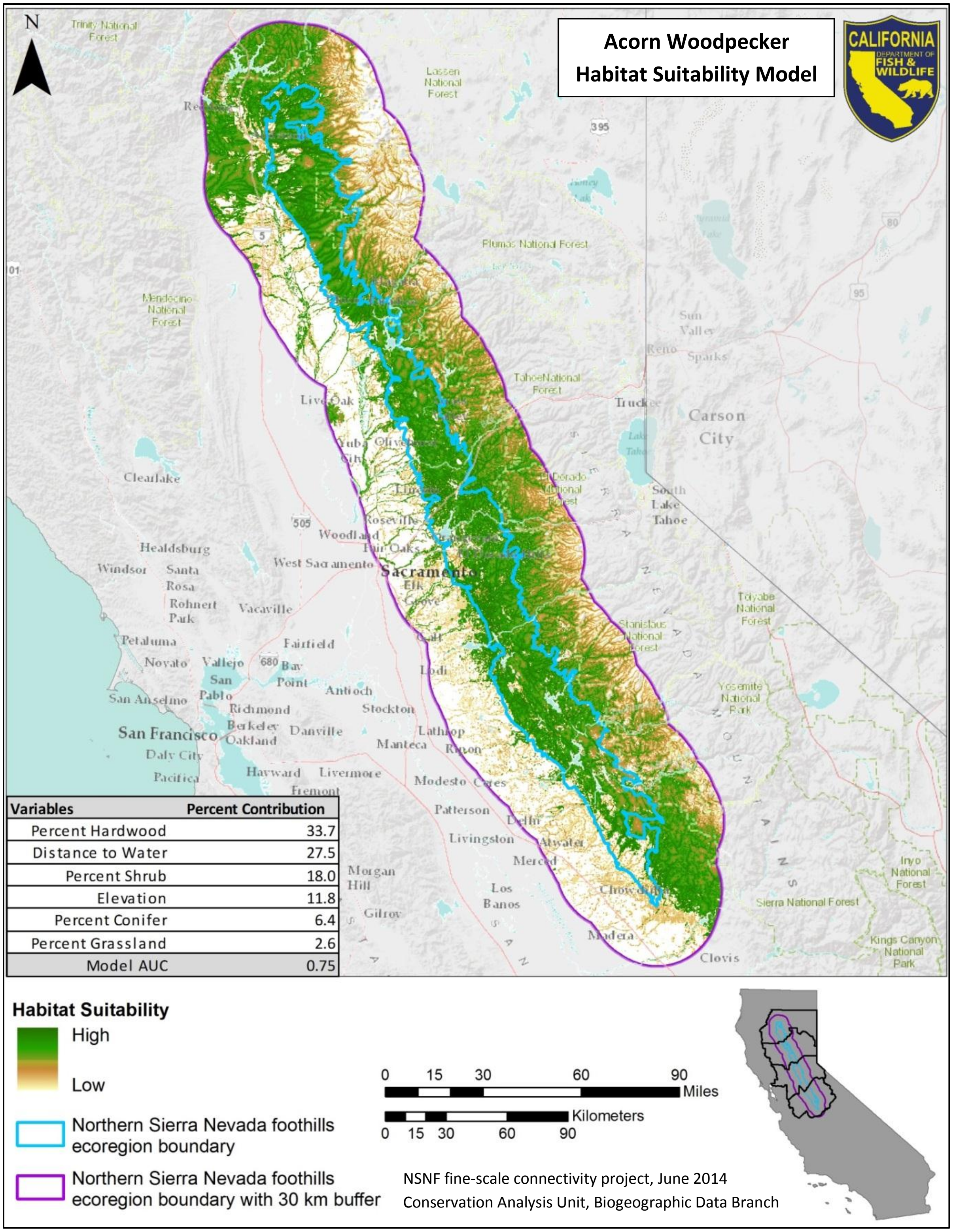
Region 4: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Merced River block are isolated from foothill blocks of Black Rascal Creek and San Luis NWR. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.75	0.29	3,359,596.5	2,392,059.4	939

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
24.7	47.5	27.8

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
230	84.7	10.0	42.2	47.8

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
19.6	42.7	82.8	48.2



Variables	Percent Contribution
Percent Hardwood	33.7
Distance to Water	27.5
Percent Shrub	18.0
Elevation	11.8
Percent Conifer	6.4
Percent Grassland	2.6
Model AUC	0.75

Figure S-1. Predicted habitat suitability for the acorn woodpecker (*Melanerpes formicivorus*). Environmental variables for the Maxent scenario 7 model included elevation, distance to water and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub).

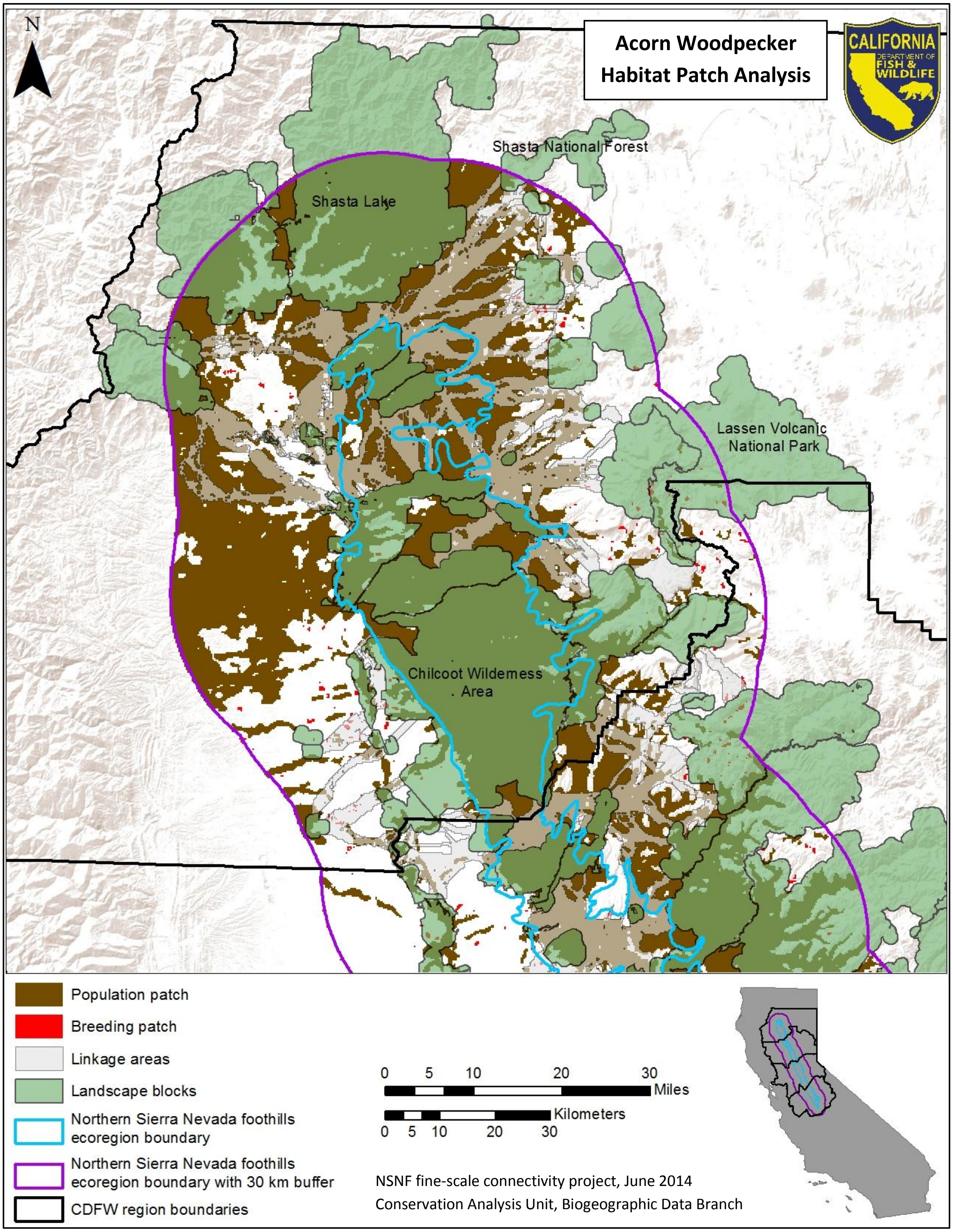


Figure S-2: Habitat patch analysis for the acorn woodpecker (*Melanerpes formicivorus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

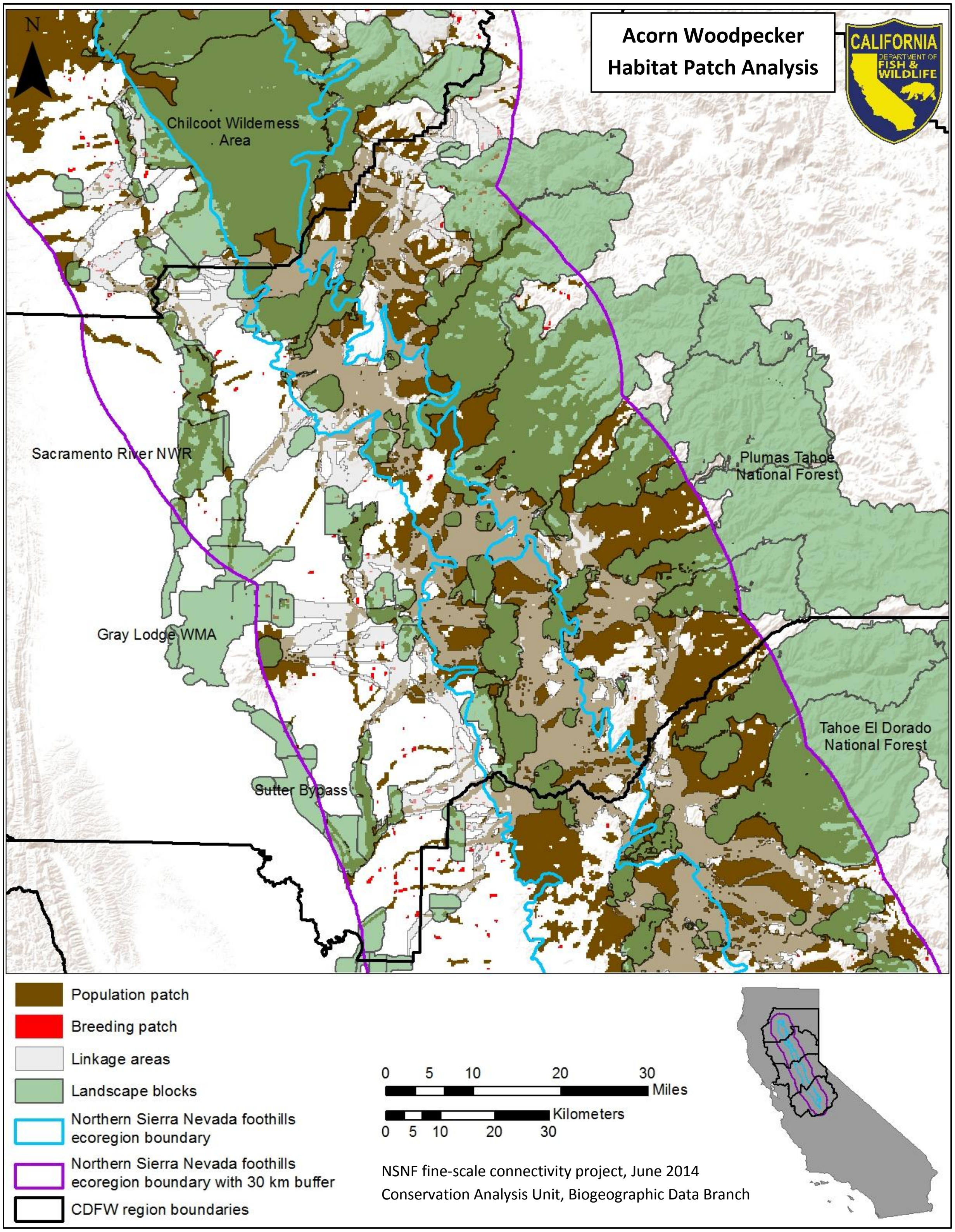


Figure S-3: Habitat patch analysis for the acorn woodpecker (*Melanerpes formicivorus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

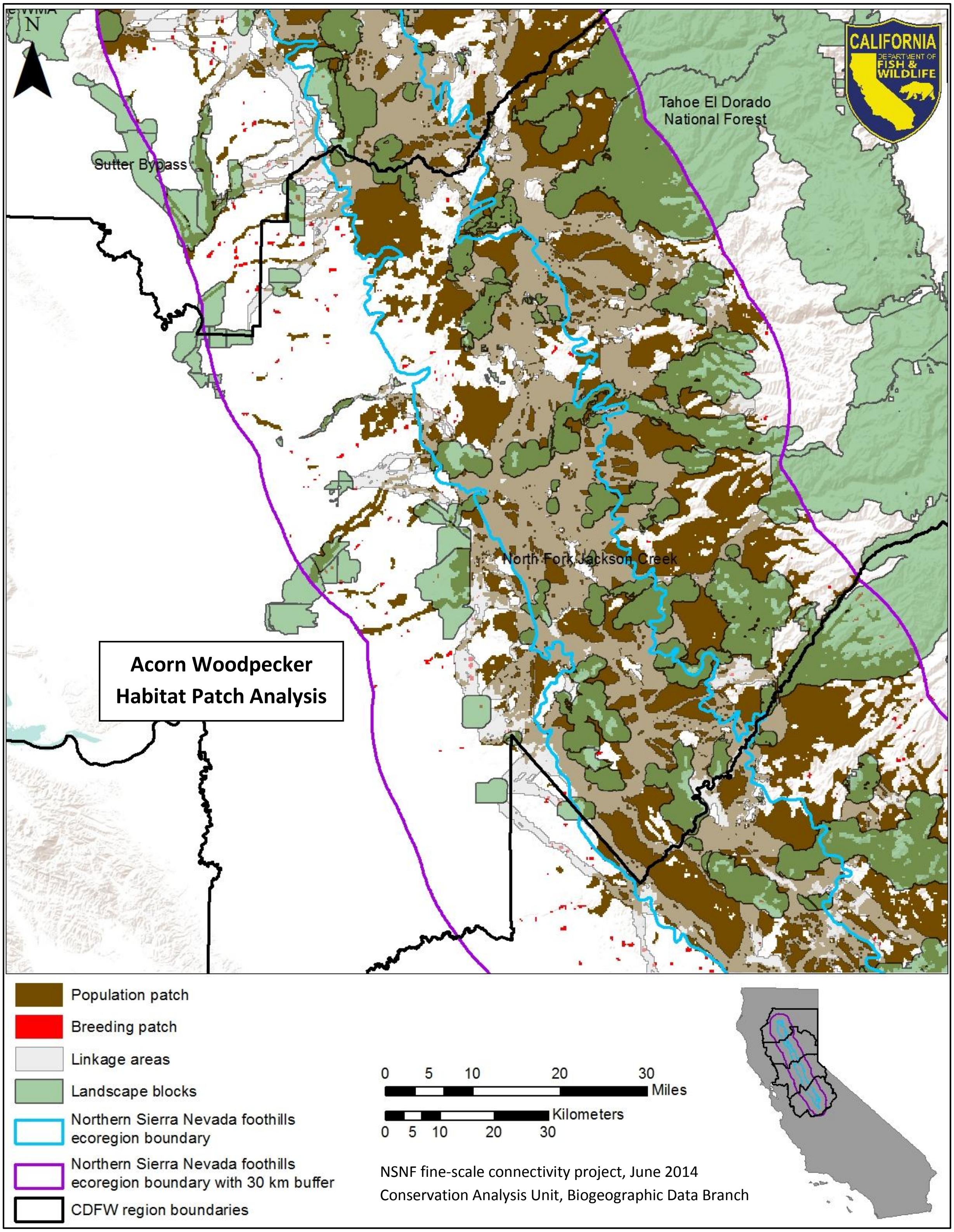


Figure S-4. Habitat patch analysis for the acorn woodpecker (*Melanerpes formicivorus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

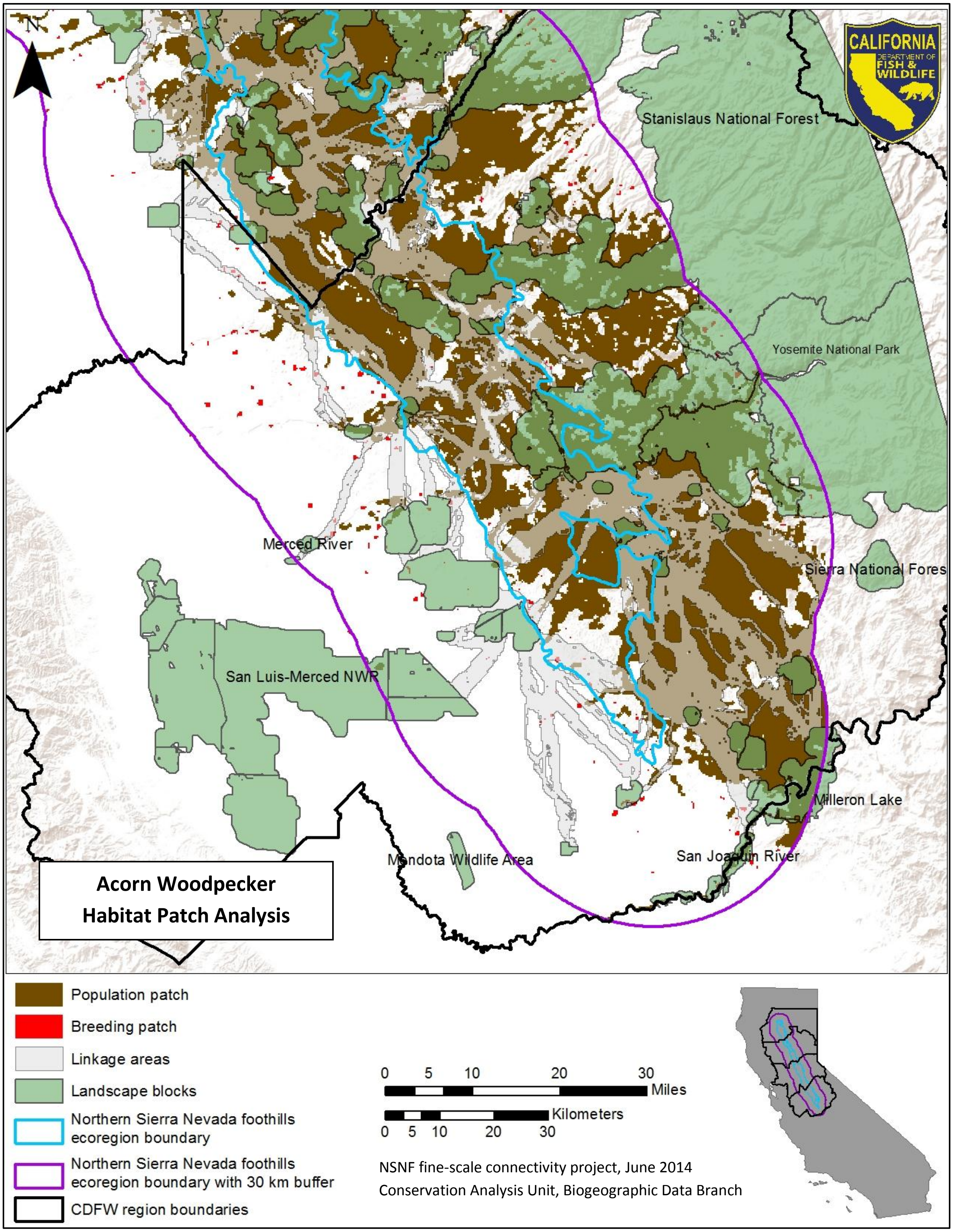


Figure S-5. Habitat patch analysis for the acorn woodpecker (*Melanerpes formicivorus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

Arboreal salamander (*Aneides lugubris*)

Focal species selection: Arboreal salamanders are **corridor dwellers**. Their greatest threats are habitat loss and pollution (Jennings 1996).

Habitat and Status: Arboreal salamanders are found throughout the foothills from El Dorado County to Madera County to around 1520 m elevation. Arboreal salamanders are only found on the surface during moist periods and occur primarily in valley-foothill hardwood, valley-foothill hardwood-conifer and mixed conifer habitats (CWHR 2008). During moist periods, this salamander crawls beneath or inside surface objects such as tree bark, rotting logs, rocks and woodrat nests and will also hide in tree cavities as high as 9.1 m (CWHR 2008). During dry periods, this salamander retreats to moist refuges such as rodent burrows, seepages, rock fissures, mine shafts, caves, water tanks and wells (CWHR 2008). The arboreal salamander deposits eggs in moist upland nesting cavities (CWHR 2008). This salamander is most abundant in areas with good surface moisture or permanent water (CWHR 2008).

Habitat Model: The final three habitat suitability models developed for arboreal salamander were the expert opinion CWHR Bioview, and Maxent scenarios 7w and 9w. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 742 location points to train each model, 186 to test each model, and 9786 background points. Environmental variables for the Maxent scenario 7w model included elevation, distance to water and vegetation represented by five continuous variables (percent wetland, percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9w model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by five continuous variables.

Patch Analysis: Home ranges of less than 60 m in the longest dimension (CWHR 2008). Minimum breeding patch size used was 1 ha; minimum population patch size was 1 ha.

Dispersal/Migration: Little movement outside of home range; may travel to moist refuges during dry periods (CWHR 2008). Maximum dispersal of 100 m.

Results and Discussion: The selected arboreal salamander habitat suitability model was Maxent scenario 9w. The model performed well with an AUC of 0.94. The mean probability threshold was 0.12 predicting 820,066.7 ha of suitable habitat. The patch analysis identified 145 population patches covering 645,240.4 ha. Fifty of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 87.7% of the total corridor area. Arboreal salamander habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 3.3% of habitat area in the corridors had high predicted suitability, 23.6% medium and 73.1% low.

Potential habitat for the arboreal salamander is confined to the southern regions of the study area.

Region 2 South: Arboreal salamander habitat is limited to the southern part of this region in the foothills and eastern side in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous from Crevis Creek and the North Fork Cosumnes River blocks south. Habitat patches were captured by most linkages.

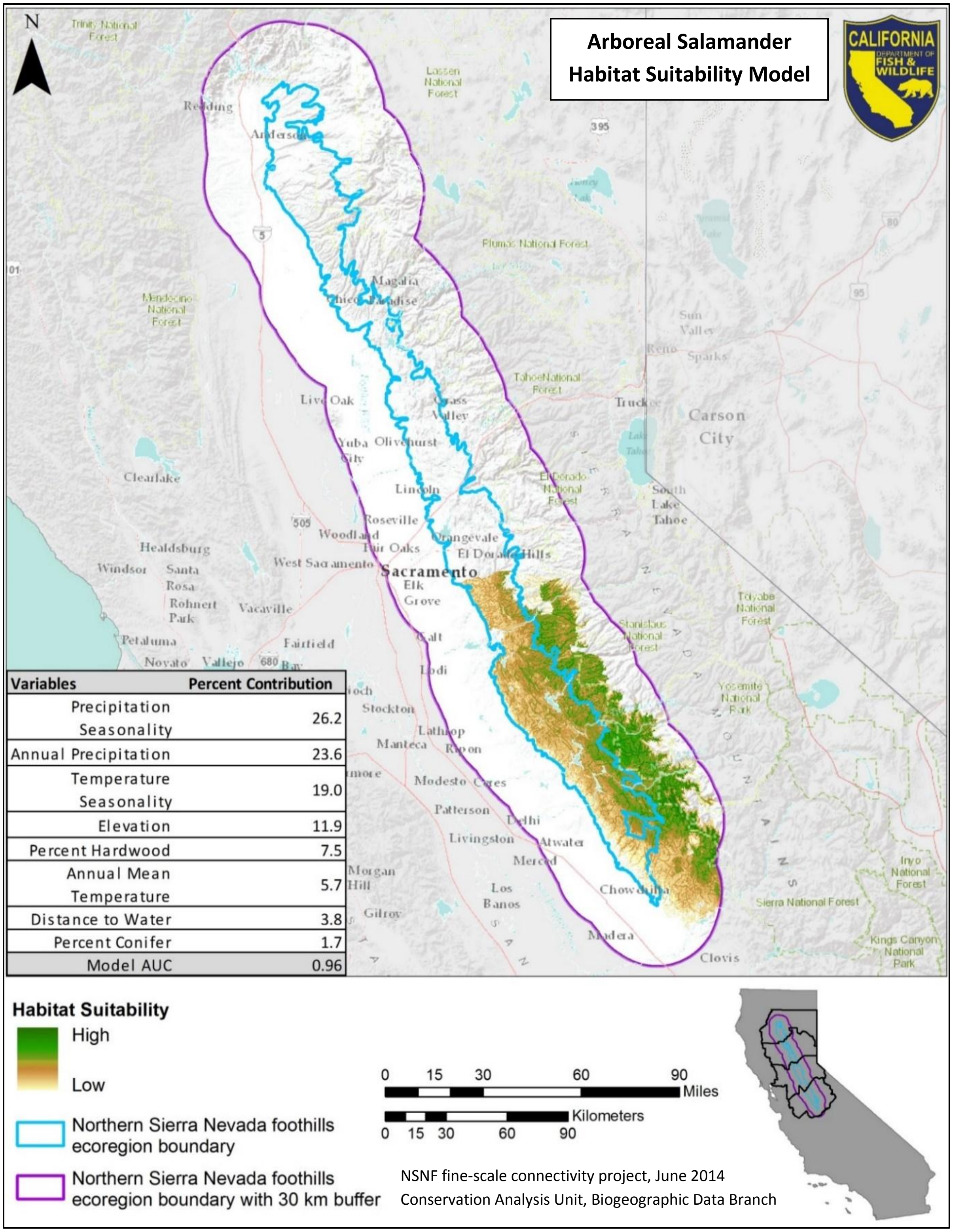
Region 4: Arboreal salamander habitat is limited to the foothills and eastern side in this of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by linkages on the eastern side of the foothills.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.96	0.10	820,066.7	645,240.4	145

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
72.9	24.0	3.1

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
50	87.7	73.1	23.6	3.3

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
47.0	46.1	49.0	46.8



Variables	Percent Contribution
Precipitation Seasonality	26.2
Annual Precipitation	23.6
Temperature Seasonality	19.0
Elevation	11.9
Percent Hardwood	7.5
Annual Mean Temperature	5.7
Distance to Water	3.8
Percent Conifer	1.7
Model AUC	0.96

Figure S-6. Predicted habitat suitability for the arboreal salamander (*Aneides lugubris*). Environmental variables for the Maxent scenario 9w included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by five continuous variables.

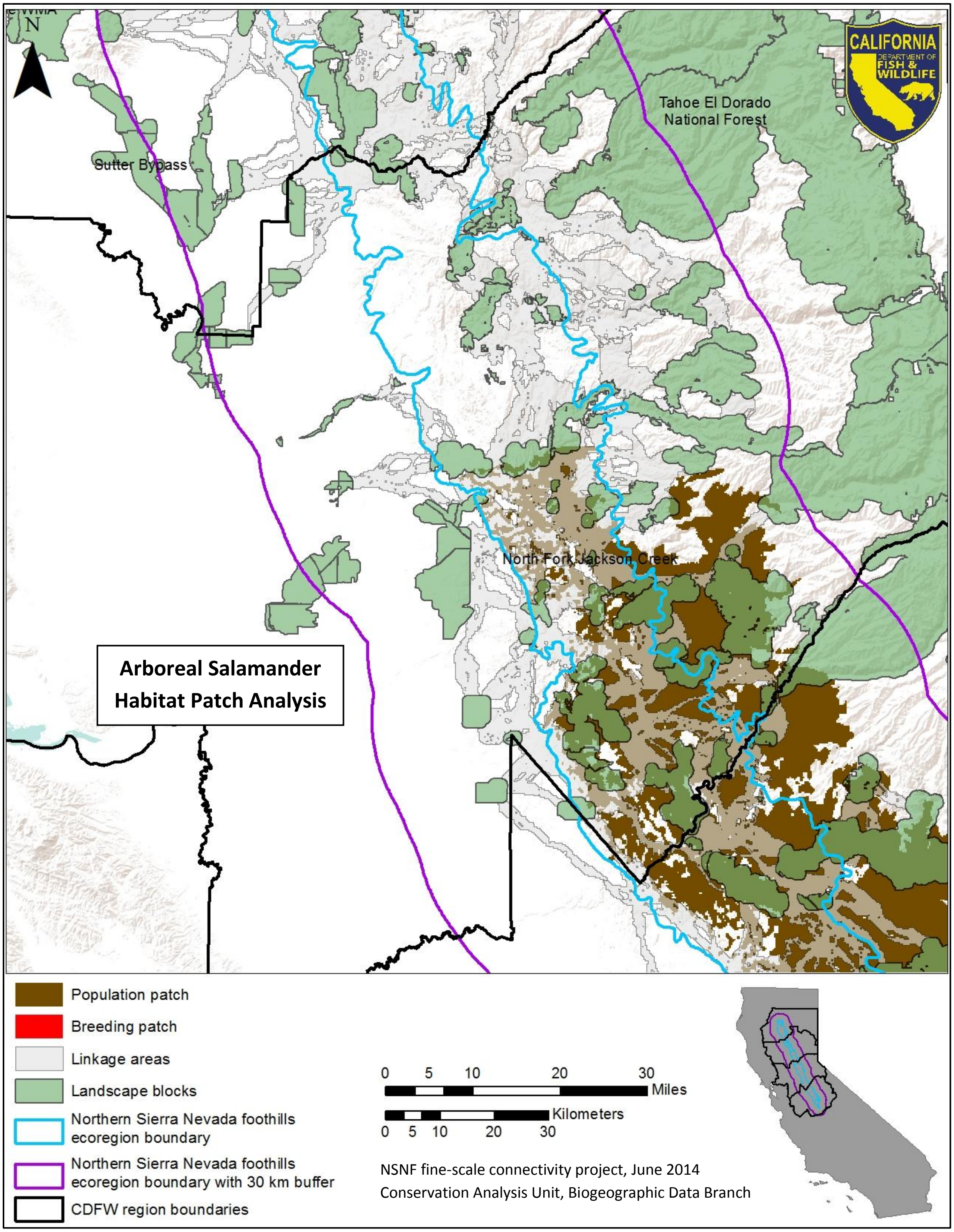


Figure S-7. Habitat patch analysis for Arboreal salamander (*Aneides lugubris*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat with >1 ha; breeding patches were contiguous areas of suitable habitat with >1 ha.

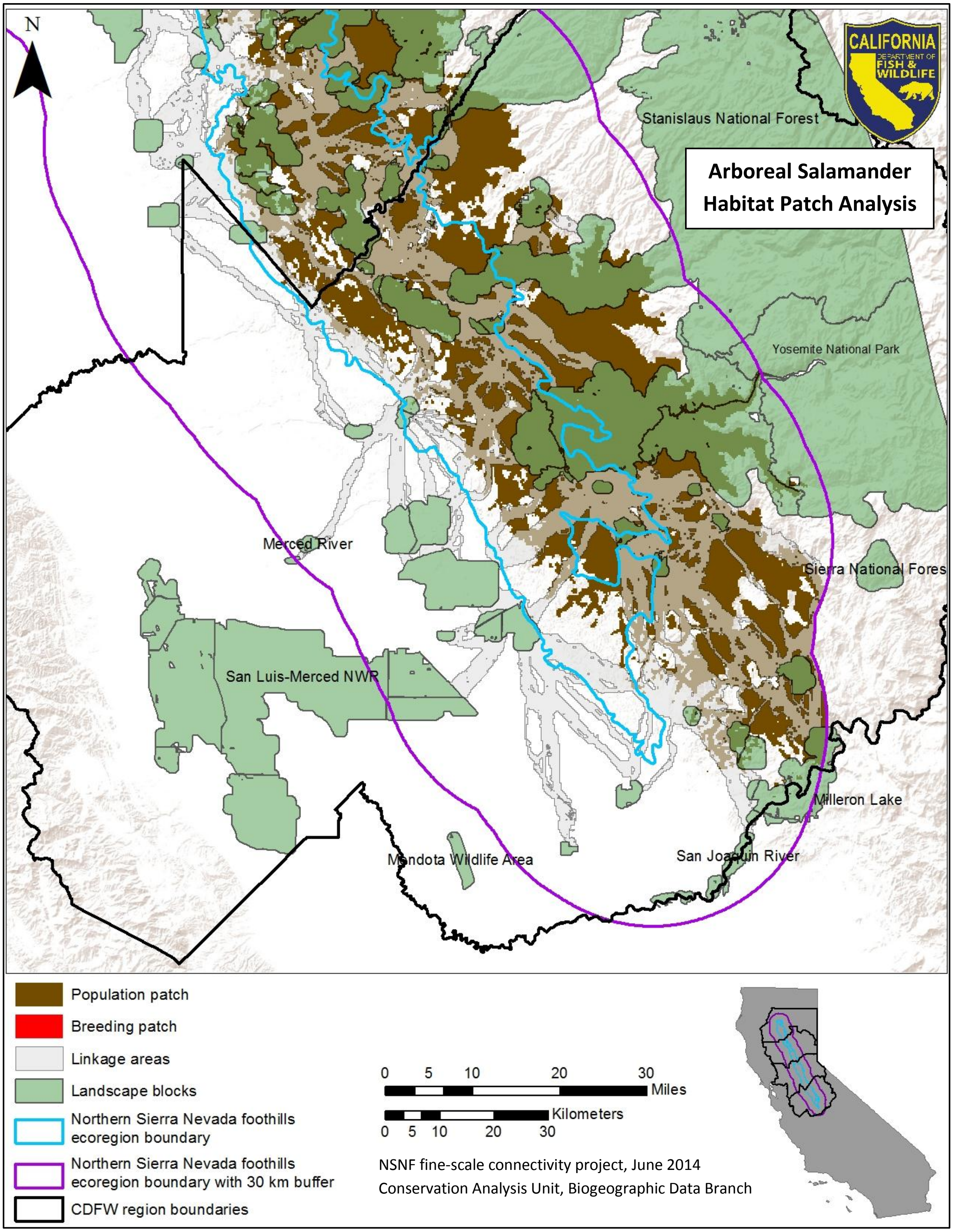


Figure S-8. Habitat patch analysis for Arboreal salamander (*Aneides lugubris*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat with >1 ha; breeding patches were contiguous areas of suitable habitat with >1 ha.

Black bear (*Ursus americanus*)

Focal Species Selection: Black bears are sensitive to habitat fragmentation and susceptible to fragmentation of large habitat patches (RCIP 2000).

Habitat and Status: Black bears are the largest foothill carnivore and need large areas to find food, cover and mates. The black bear met the selection criteria of **area sensitive**, **barrier sensitive** and **habitat specialist**. Throughout the Sierra Nevada, black bears can be found in mixed conifer and upper montane belts at 1,200 to 8,500 ft. The species inhabits forested areas or thickets, sheltering in caves, rock piles or hollow trees (Zeiner, Laudenslayer et al. 1990, CWHR 2008).

Habitat Model: The final three habitat suitability models developed for black bear were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 440 location points to train each model, 110 to test each model, and 9863 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Black bears have large home ranges: Van Vuren (1998) found the home range of black bears in northwest California in summer for males varied from 2.6 to 19.7 km2 and females 1.8 to 4.4 km^2. For our patch analysis we selected a minimum patch size of 1,000 ha and minimum population patch size of 5,000 ha (Beier, Penrod et al. 2006) and a maximum dispersal distance of 25.9 km (Van Vuren 1998).

Results and Discussion: The selected black bear habitat suitability model was Maxent scenario 9. The model performed well with an AUC of 0.94. The mean probability threshold was 0.12, predicting 2,214,680.1 ha of suitable habitat. The patch analysis identified 23 breeding patches covering 28,087.9 ha and 59 population patches covering 911,590.0 ha. We identified 47 black bear least-cost corridors. Habitat patches covered 71.8% of the total corridor area. The majority of corridors were on the eastern side of the study area and ranged in elevation from 173 m to 2,072 m. The least-cost corridors covered 198,354.2 ha of land, of those 15.9% were designated as GAP 1, 2 or 3 lands or in conservation easements, 84.1% are private lands. Black bear corridors covered many different vegetation types, for total area of corridors 20% were in mixed conifer, 19% in hardwood and 18% in oak woodland. Black bear habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 15.2% of habitat area in the corridors had high predicted habitat suitability, 62.7% medium and 22.1% low.

Potential habitat for the black bear is widespread throughout the foothills and eastern side of the study area.

Region 1: Habitat is scattered on the eastern side in this region of the study area. Six of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat is limited to the eastern side in this region of the study area. Habitat patches between Chilcoot Wildnerness Area block south to the Lake Earl Wildlife area block are only connected through the Plumas-Tahoe NF blocks and not through corridors. Fifteen of the corridors are in this region of the study area and capture most of the habitat patches in the south of this region.

Region 2 South: Habitat is fairly continuous in this region. Twenty-seven of the corridors are in this region of the study area and capture most of the habitat patches.

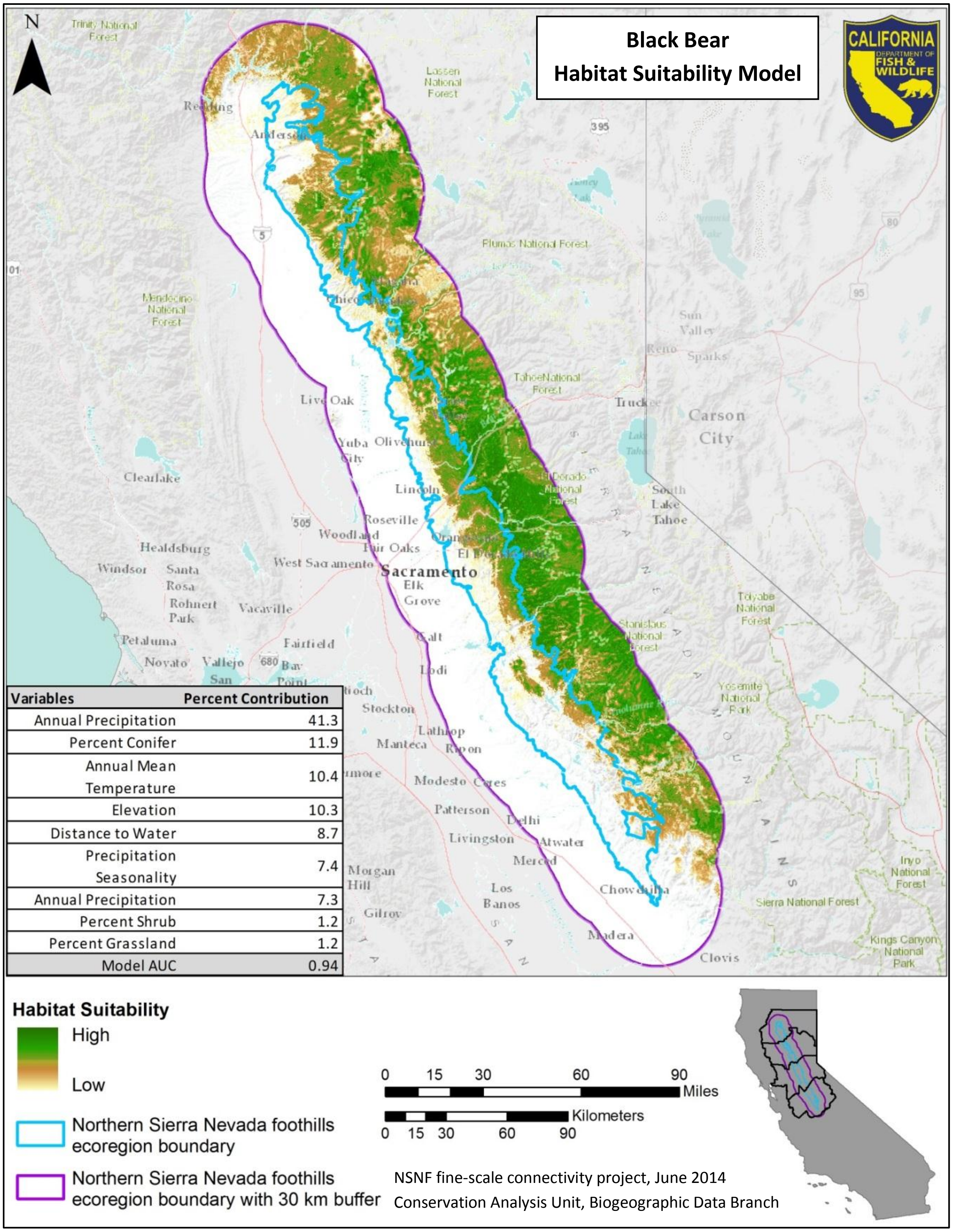
Region 4: Habitat is limited to eastern side in this region of the study area. Only two of the corridors are in this region of the study area.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.94	0.12	2,214,680.1	978,168.4	623

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
51.4	43.6	5.0

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
47	71.8	22.1	62.7	15.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
3.6	12.2	25.8	8.5



Variables	Percent Contribution
Annual Precipitation	41.3
Percent Conifer	11.9
Annual Mean Temperature	10.4
Elevation	10.3
Distance to Water	8.7
Precipitation Seasonality	7.4
Annual Precipitation	7.3
Percent Shrub	1.2
Percent Grassland	1.2
Model AUC	0.94

Figure S-9. Predicted habitat suitability for the black bear (*Ursus americanus*). Environmental variables for the Maxent scenario 9 included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

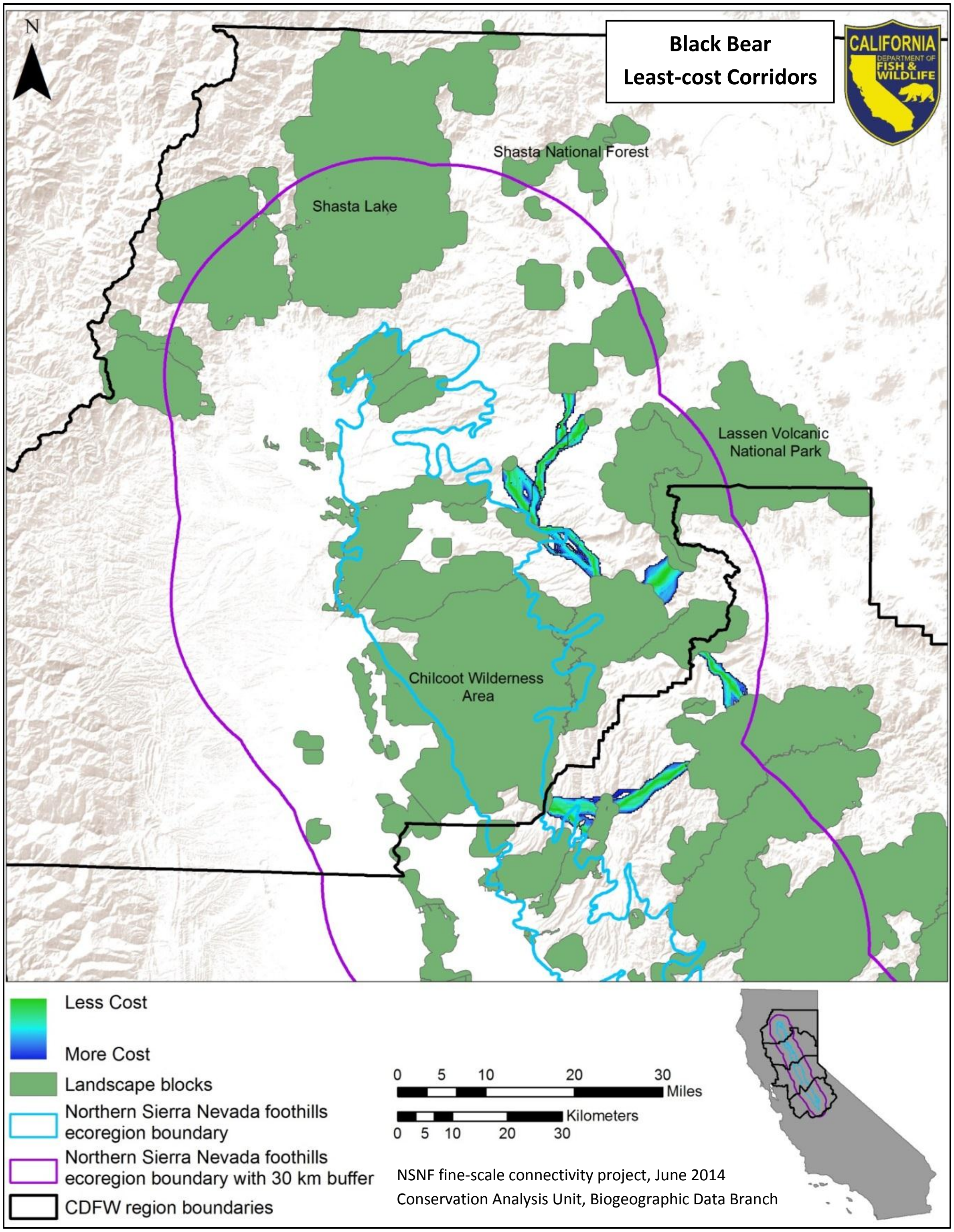


Figure S-10. Least-cost corridor analysis for the black bear (*Ursus americanus*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

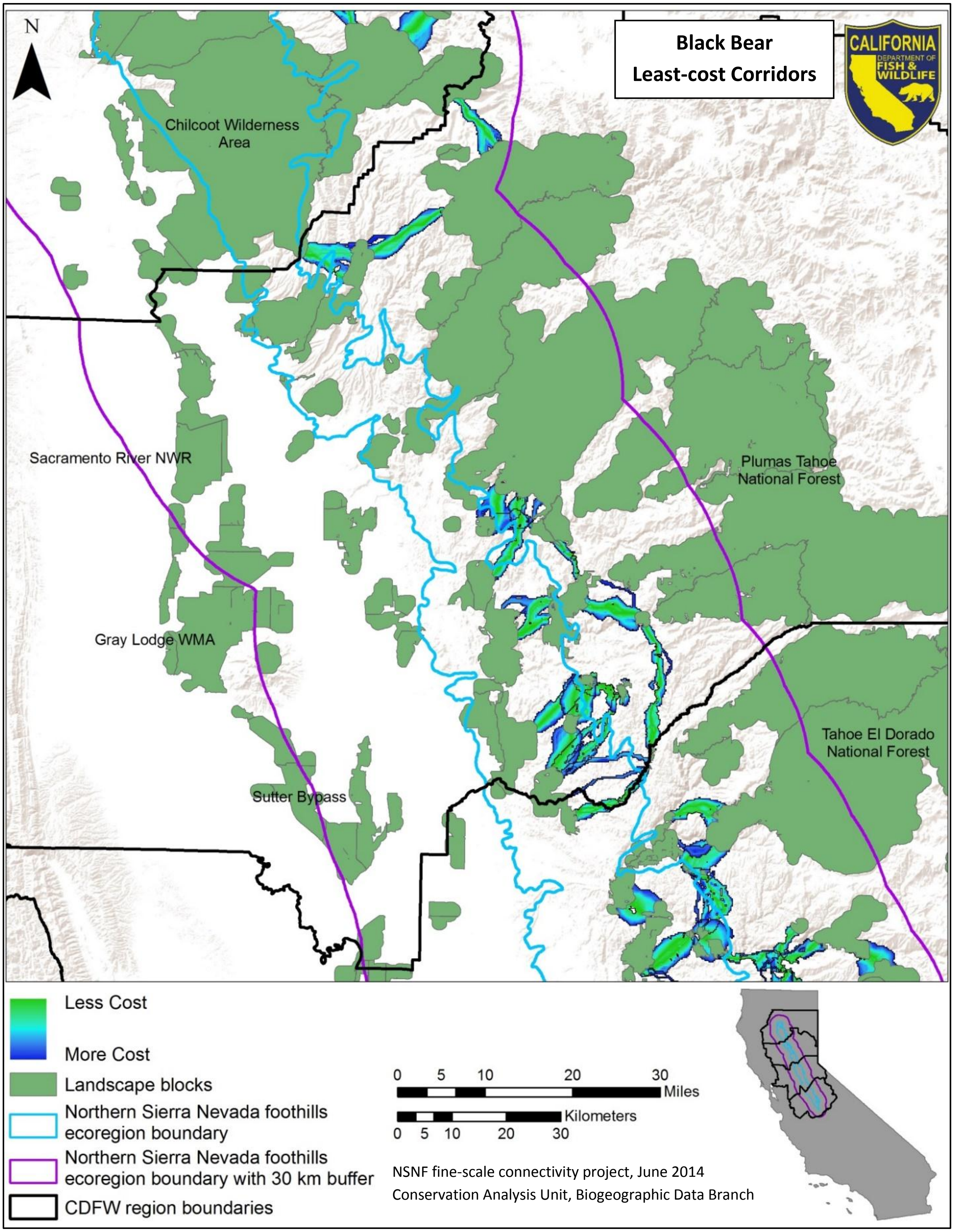


Figure S-11. Least-cost corridor analysis for the black bear (*Ursus americanus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

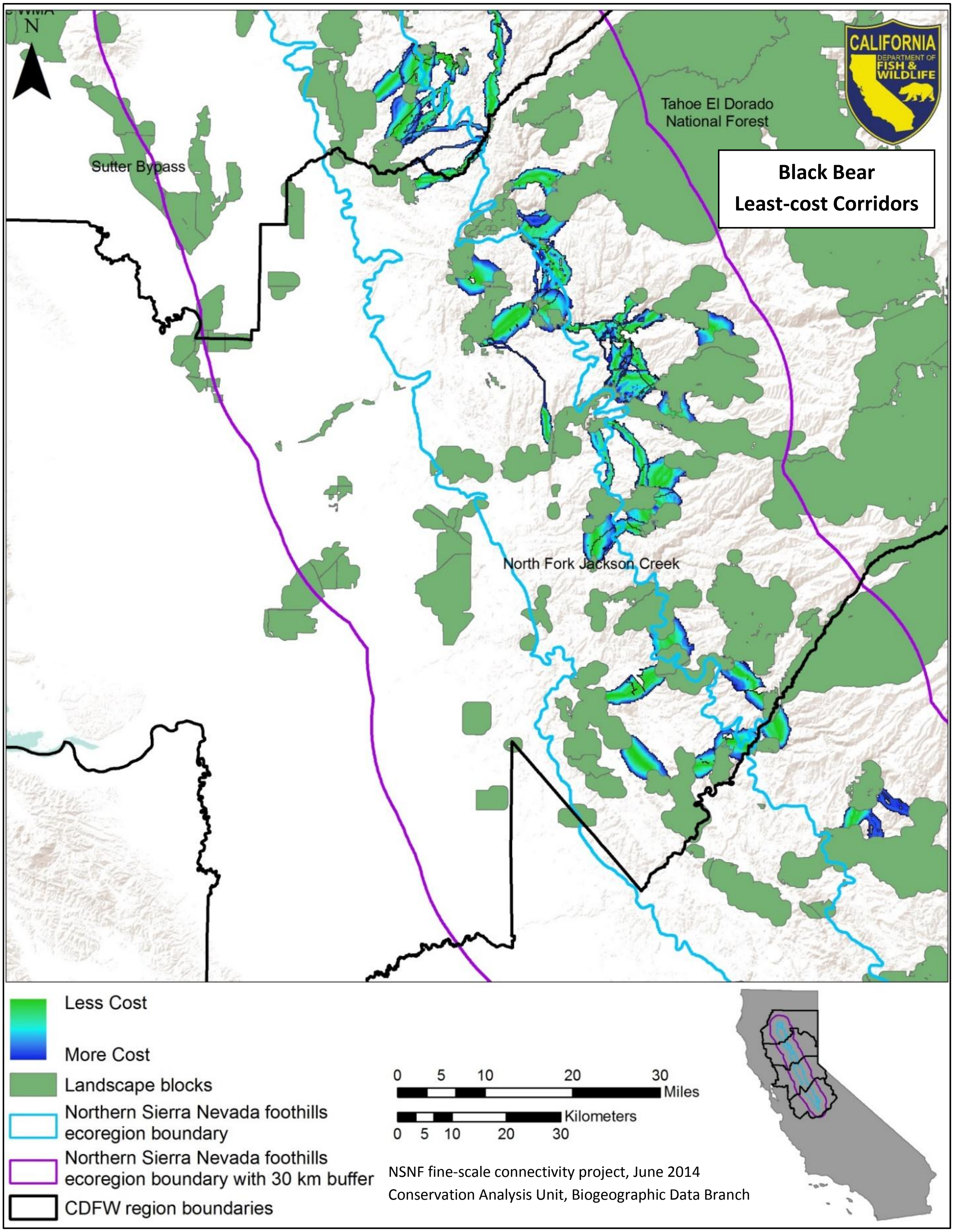


Figure S-12. Least-cost corridor analysis for the black bear (*Ursus americanus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

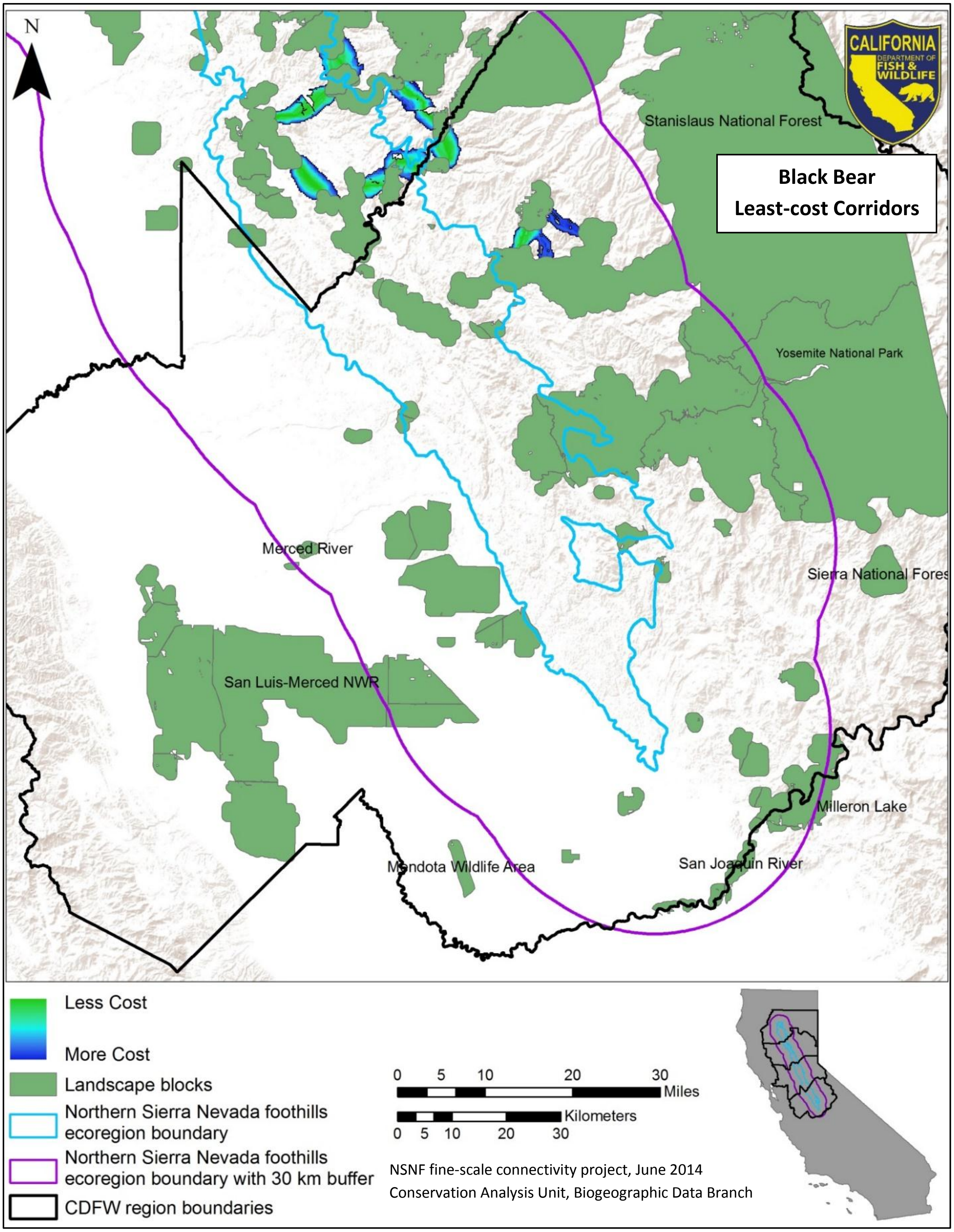


Figure S-13: Least-cost corridor analysis for the black bear (*Ursus americanus*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Black-tailed jackrabbit (*Lepus californicus*)

Focal species selection: Black-tailed jackrabbits are common throughout the state, except at the highest elevations (CWHR 2008). This jackrabbit is abundant at lower elevations in herbaceous and desert shrub areas and open, early stages of forest and chaparral habitats (CWHR 2008). Shrubs are used for cover and water is not necessary (CWHR 2008). Black-tailed jackrabbits are **barrier sensitive** and are important prey species.

Habitat Model: The final three habitat suitability models developed for black-tailed jackrabbit were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 201 location points to train each model, 51 to test each model, and 9925 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: In California the average home range was 18.5 ha (Lechleitner 1958). Minimum breeding patch size used was 18.5 ha; minimum population patch size was 460 ha.

Dispersal/Migration: Black-tailed jackrabbits do not migrate. Maximum dispersal distance of 1.2 km (Van Vuren 1998).

Results and Discussion: The selected black-tailed jackrabbit habitat suitability model was Maxent scenario 9. The model performed well with an AUC of 0.80. The mean probability threshold was 0.31, predicting 1,848,875.2 ha of suitable habitat. The patch analysis identified 865 breeding patches covering 60,316.1 ha and 504 population patches covering 1,819,732.1 ha. We identified 65 black-tailed jackrabbit least-cost corridors. Habitat patches covered 73.1% of the total corridor area. The majority of corridors were on the western side of the study area and ranged in elevation from 10 m to 1,444 m. The least-cost corridors covered 626,727.4 ha of land, of those 9.7% were designated as GAP 1, 2 or 3 lands or in conservation easements, 90.8% are private lands. Black-tailed jackrabbit corridors covered many different vegetation types, for total area of corridors 33% were in the grassland vegetation classification, 30% in oak woodland, 10% in row or field crops and 9% in hardwood. Black-tailed jackrabbit habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 0.1% of habitat in the corridors had high predicted habitat suitability, 33.8% medium and 66.1% low.

Potential habitat for the black-tailed jackrabbit is scattered throughout the foothills and western side of the study area.

Region 1: Habitat is fairly continuous on the western side and in the foothills in this region of the study area. Habitat patches on the eastern side are isolated from the main foothill blocks. Eleven of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat patches are fairly continuous. Thirty-one of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat patches on the western side near the American River Parkway blocks south to the Cosumnes River Ecological Reserve block are isolated from the main foothill blocks. Habitat patches in the foothills are fairly continuous. Forty-three of the corridors are in this region of the study area and capture most of the habitat patches.

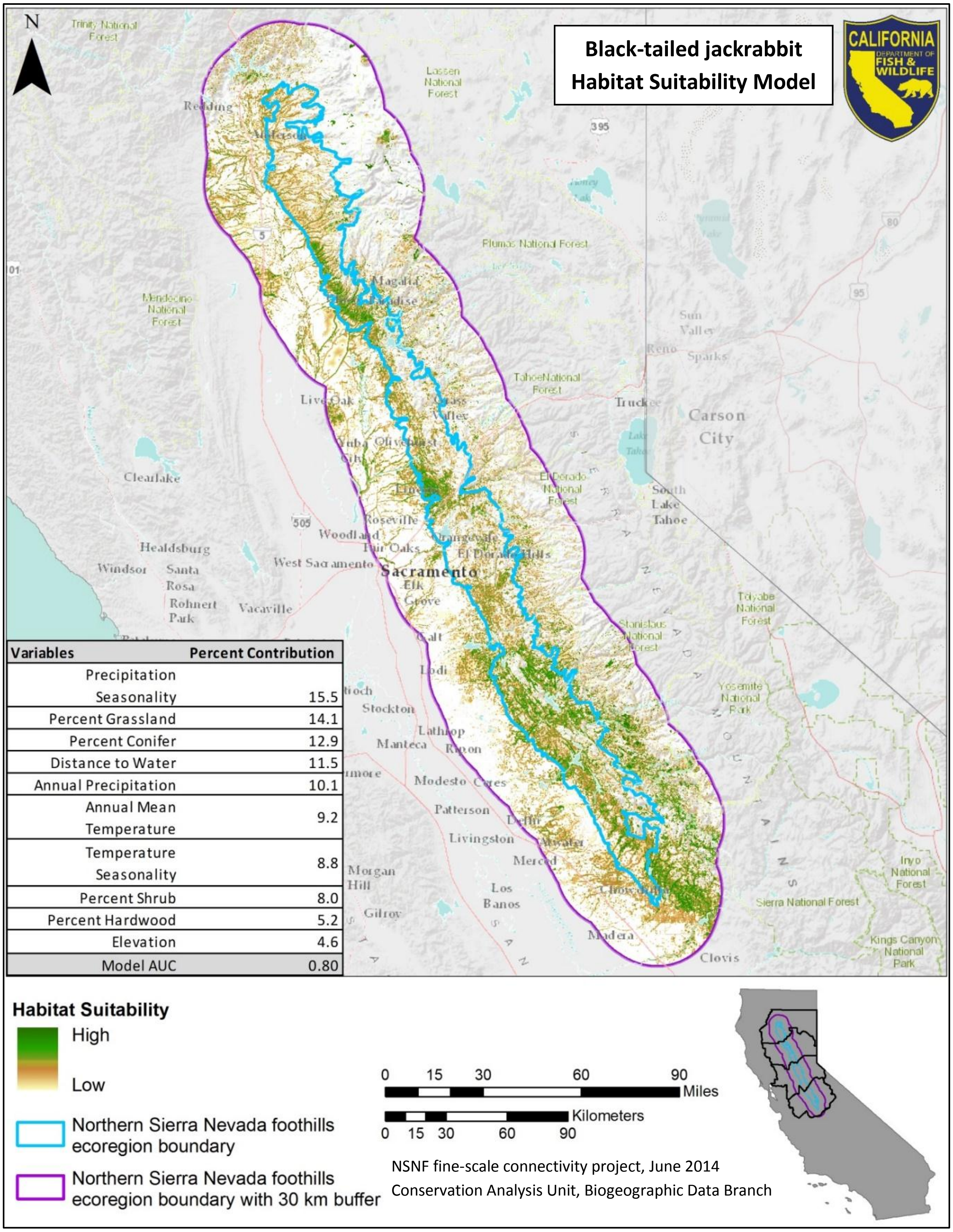
Region 4: Habitat is fairly continuous in this region of the study area. A few scattered patches to the far south are isolated from the main foothill blocks. Twenty-nine of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.80	0.31	1,848,875.2	1,848,875.2	2,571

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
77.7	22.0	0.3

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
65	73.1	66.1	33.8	0.1

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
12.2	21.9	4.5	14.3



Variables	Percent Contribution
Precipitation Seasonality	15.5
Percent Grassland	14.1
Percent Conifer	12.9
Distance to Water	11.5
Annual Precipitation	10.1
Annual Mean Temperature	9.2
Temperature Seasonality	8.8
Percent Shrub	8.0
Percent Hardwood	5.2
Elevation	4.6
Model AUC	0.80

Figure S-14. Predicted habitat suitability for the black-tailed jackrabbit (*Lepus californicus*). Environmental variables for the Maxent scenario 9 included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

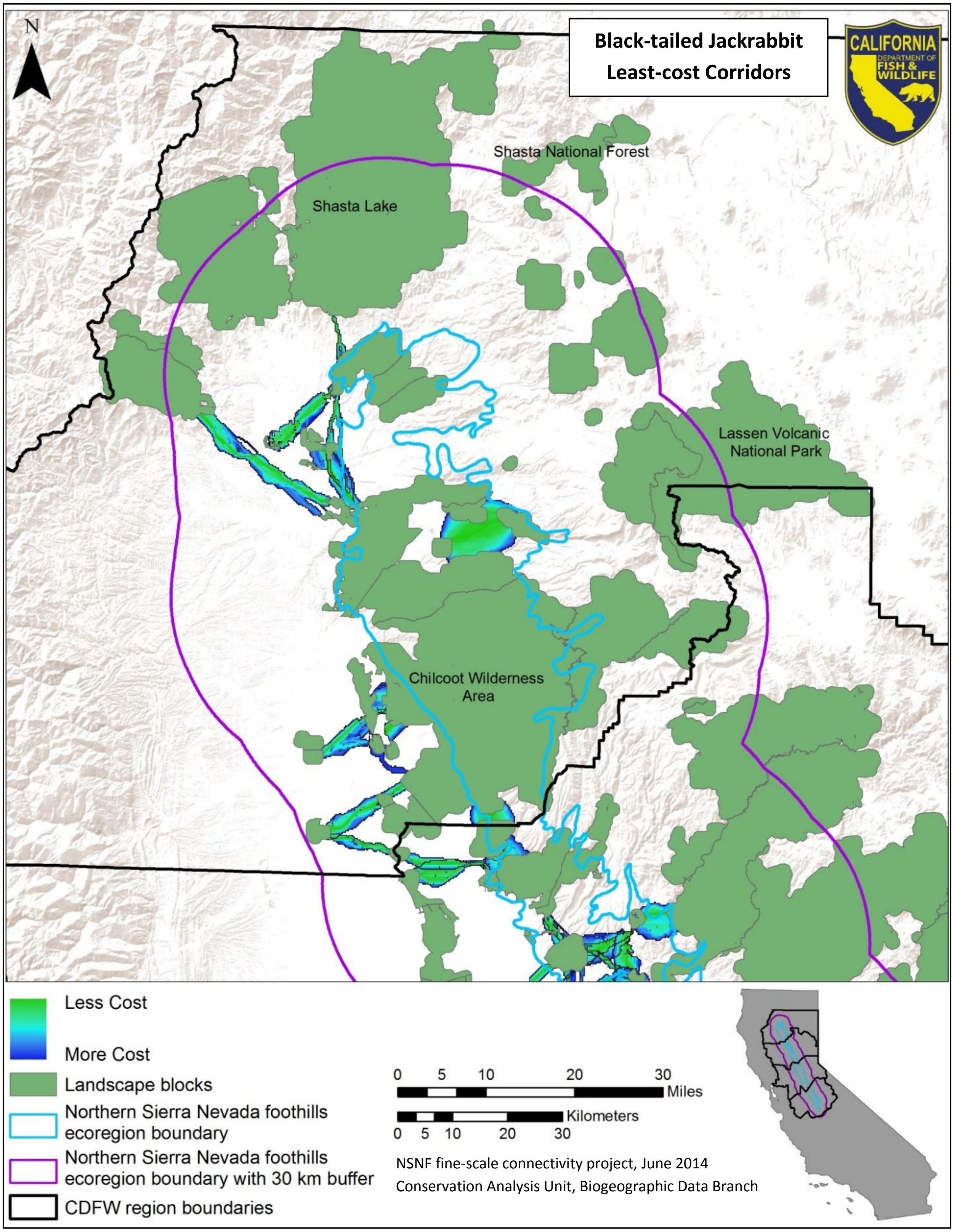


Figure S-15. Least-cost corridor analysis for the black-tailed jackrabbit (*Lepus californicus*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

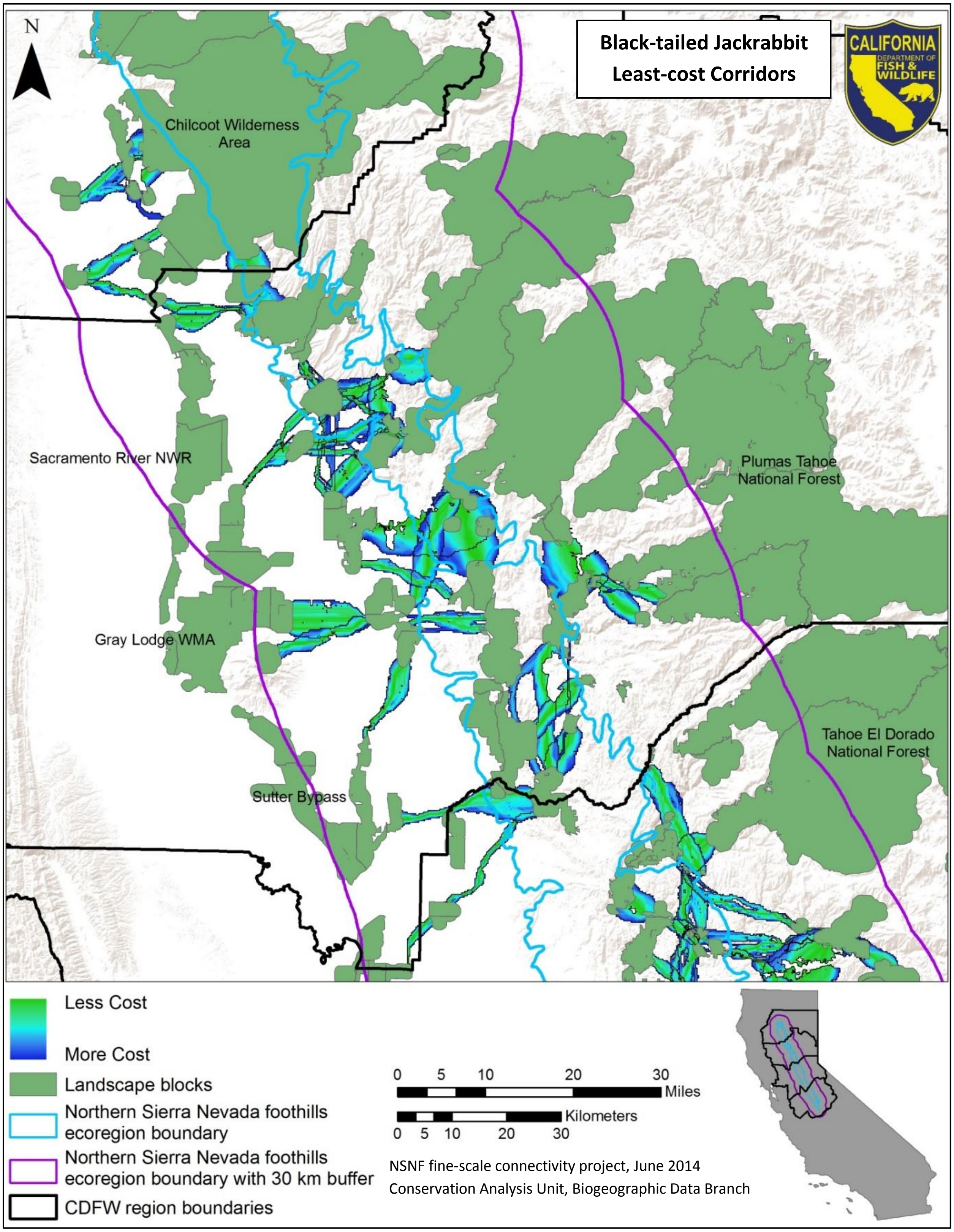


Figure S-16. Least-cost corridor analysis for the black-tailed jackrabbit (*Lepus californicus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

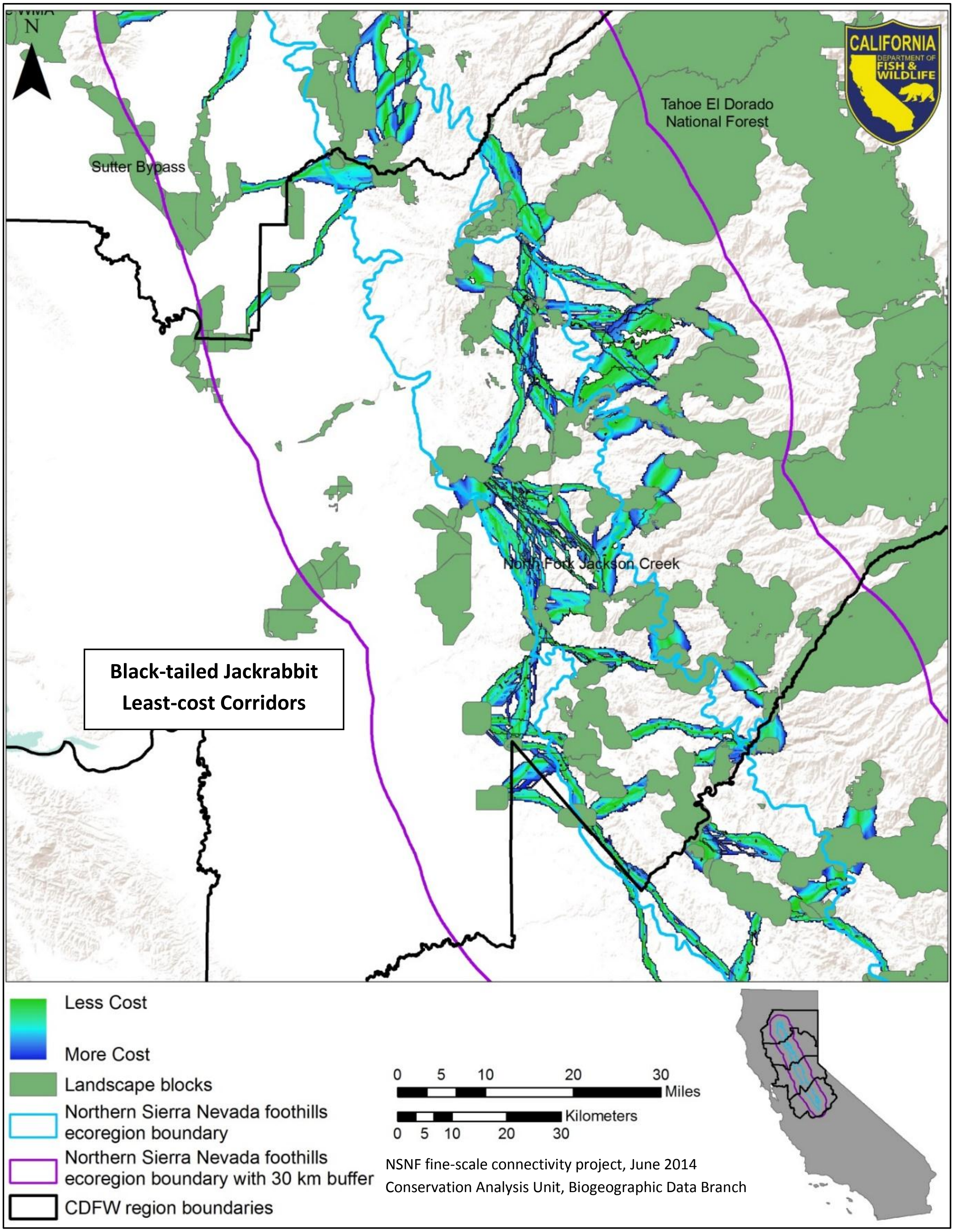


Figure S-17. Least-cost corridor analysis for the black-tailed jackrabbit (*Lepus californicus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

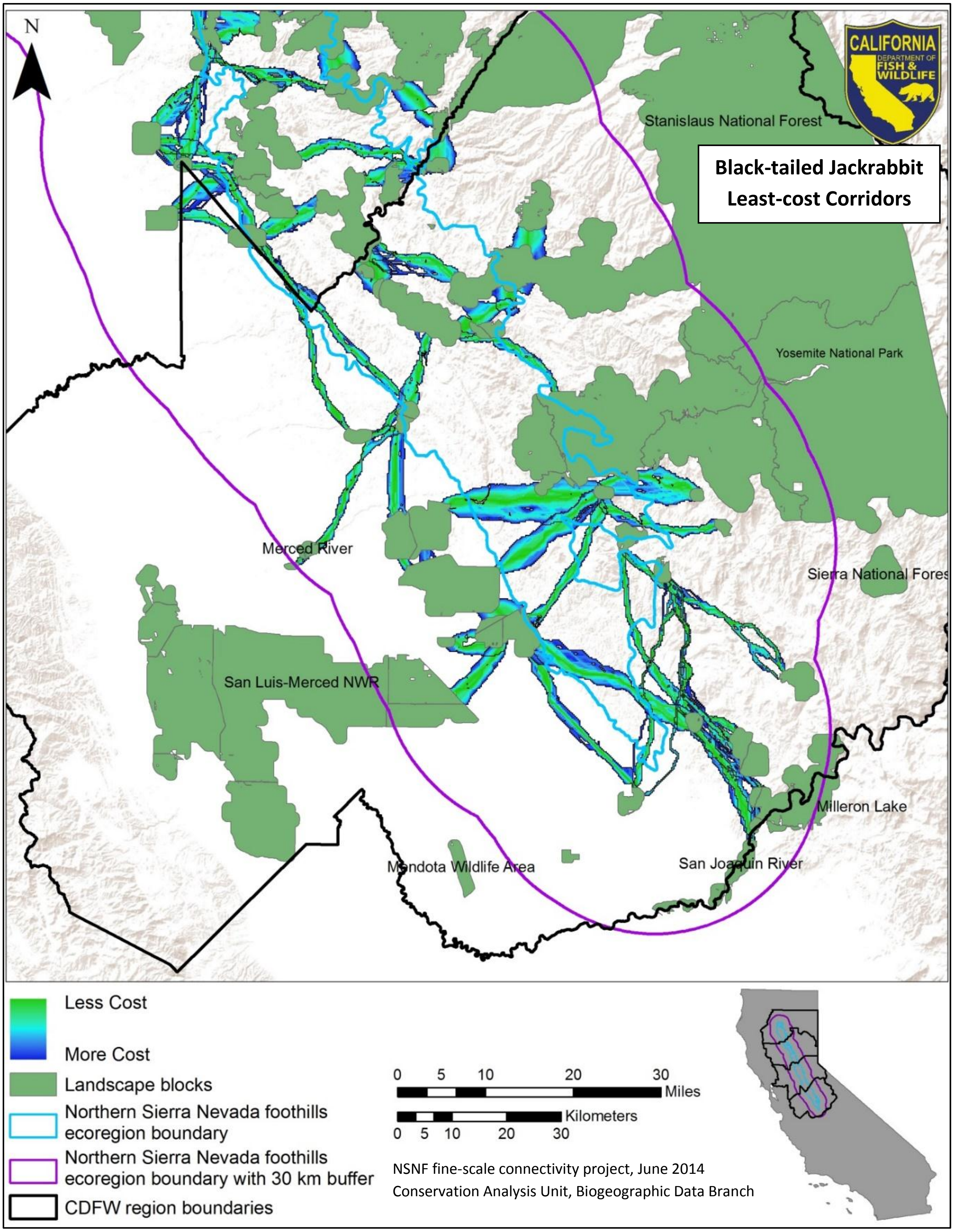


Figure S-18. Least-cost corridor analysis for the black-tailed jackrabbit (*Lepus californicus*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Bobcat (*Lynx rufus*)

Focal species selection: Bobcats are common to uncommon permanent residents throughout most of California and use nearly all habitats and successional stages. Optimal habitats are brushy stages of low and mid-elevation conifer, oak, riparian and pinyon-juniper forests and all stages of chaparral (CWHR 2008). Bobcats use cavities in rock areas, hollow logs, snags, stumps and dense brush for cover and den sites (CWHR 2008). No information on water needs are available, although they probably need to drink water regularly (CWHR 2008). Bobcats are **area sensitive**.

Habitat Model: The final three habitat suitability models developed for bobcat were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 300 location points to train each model, 76 to test each model, and 9896 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Female home ranges usually overlap very little, those of males may overlap other males or females (Bailey 1974). In Riverside County California home ranges of seven bobcats varied from 4.7-53.6 km^2 with a mean of 26.3 km^2 (Zezulak and Schwab 1980). Minimum breeding patch size used was 900 ha; minimum population patch size was 4,500 ha.

Dispersal/Migration: The species is non-migratory, and can travel distances from 2.6 km for an adult female to 4.8 km for adult males in a 24-hour period (CWHR 2008). The maximum dispersal distance used was 576 km (Penrod, Cabanero et al. 2008).

Results and Discussion: The selected bobcat habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data. The CWHR Bioview model AUC was 0.56. The CWHR Bioview model predicted 4,235,118.2 ha of suitable habitat. The patch analysis identified 39 breeding patches covering 54,994.5 ha and 84 population patches covering 1,555,357.9 ha. We identified 83 bobcat least-cost corridors. Habitat patches covered 87.6% of the total corridor area. The corridors were identified throughout the study area and ranged in elevation from 18 m to 2031 m. The least-cost corridors covered 390,946.5 ha of land, of those 13.4% were designated as GAP 1, 2 or 3 lands or in conservation easements and 87.2% were private lands. Bobcat corridors covered many different vegetation types: 49% of the total corridor area was in oak woodland vegetation, 12% in grassland, 11% in chaparral and 11%in hardwood. Bobcat habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 53.4% of habitat area in the corridors had high predicted suitability, 32.8% medium and 13.8% low.

Potential habitat for the bobcat is scattered throughout the foothills and eastern side of the study area.

Region 1: Habitat is fairly continuous in this region of the study area. Habitat patches on the eastern side are isolated from the main foothill blocks. Eighteen of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat patches are scattered in the foothills and eastern side in this region of the study area. Patches of the eastern side are isolated from the main foothill blocks. Twenty-one of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat patches in the foothills are fairly continuous. Thirty-two of the corridors are in this region of the study area and capture most of the habitat patches.

Region 4: Habitat is fairly continuous in this region of the study area. Fifteen of the corridors are in this region of the study area and capture most of the habitat patches.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.56	n/a	4,235.118.2	1,705,149.9	1,397

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
59.1	26.3	14.7

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
83	87.6	13.8	32.8	53.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
2.2	11.6	33.7	9.3

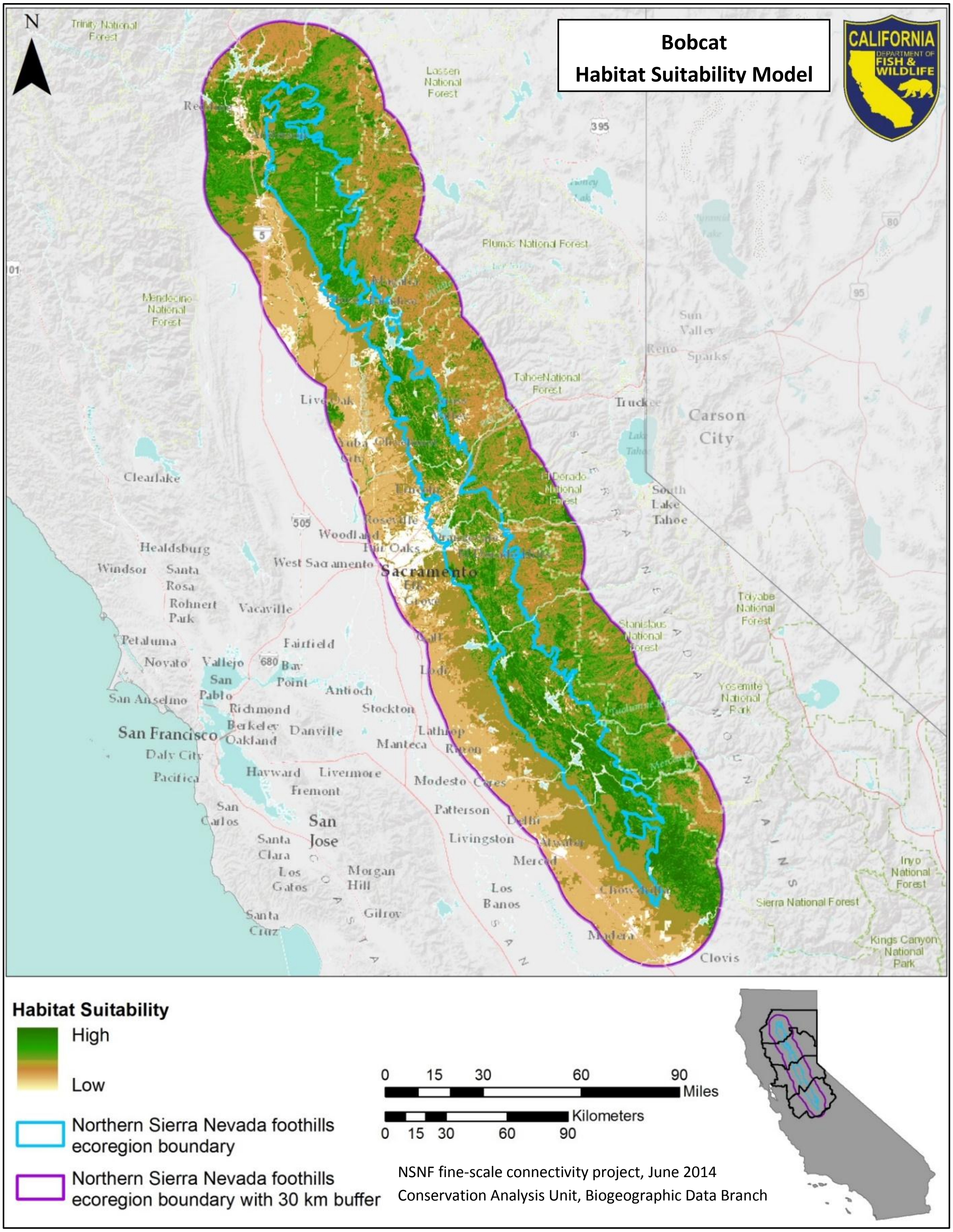


Figure S-19. Predicted habitat suitability for the bobcat (*Lynx rufus*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes.

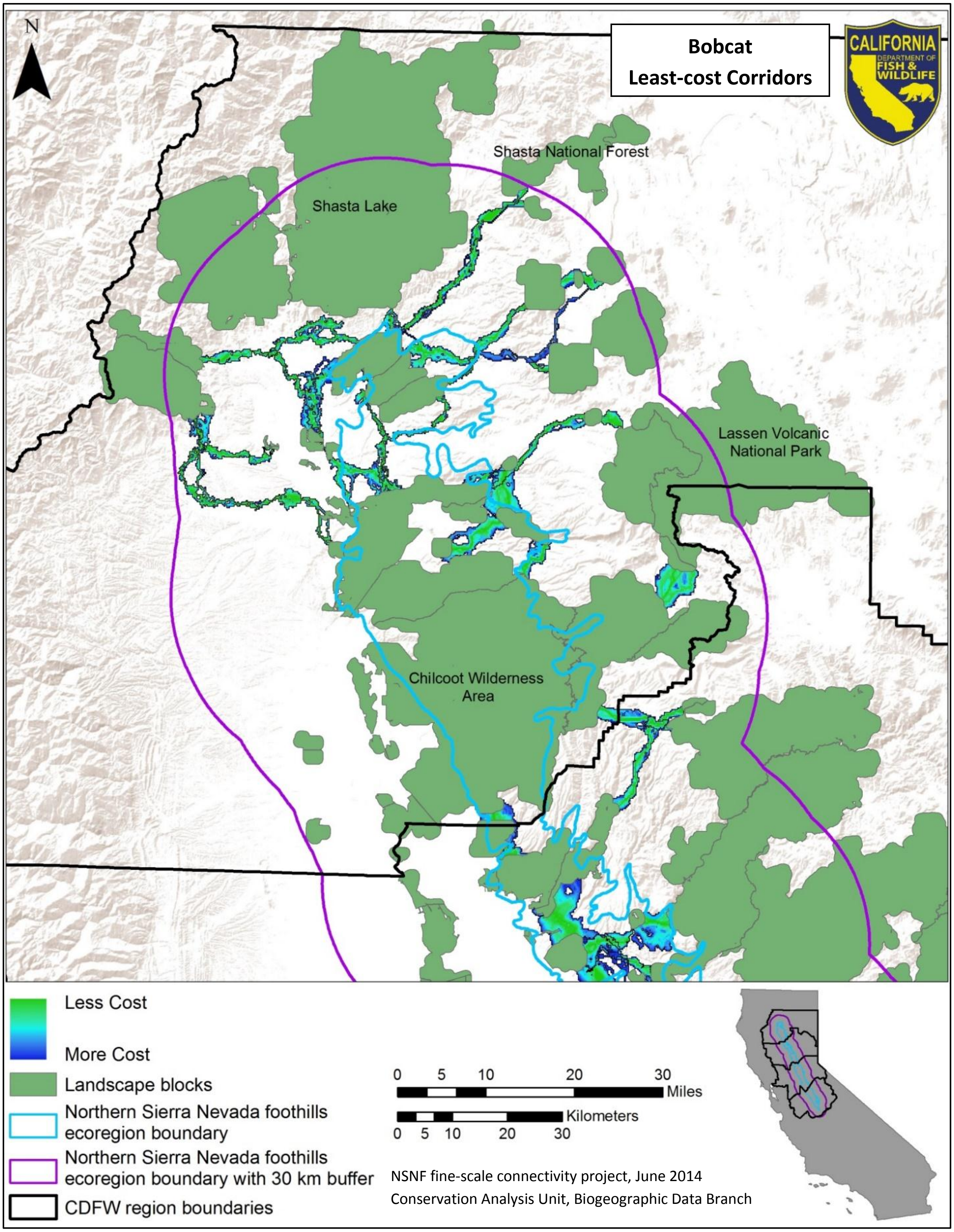


Figure S-20. Least-cost corridor analysis for the bobcat (*Lynx rufus*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

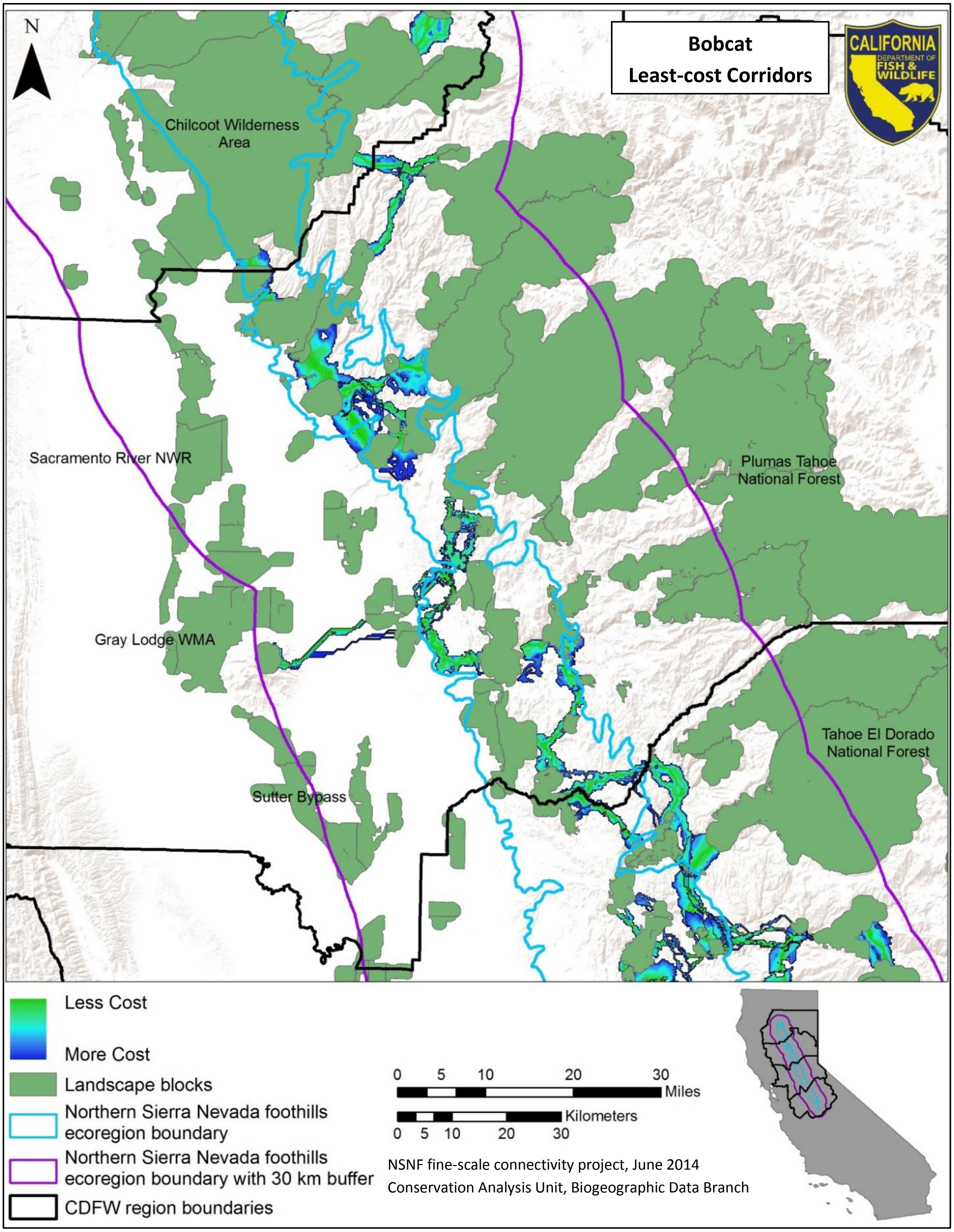


Figure S-21. Least-cost corridor analysis for the bobcat (*Lynx rufus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

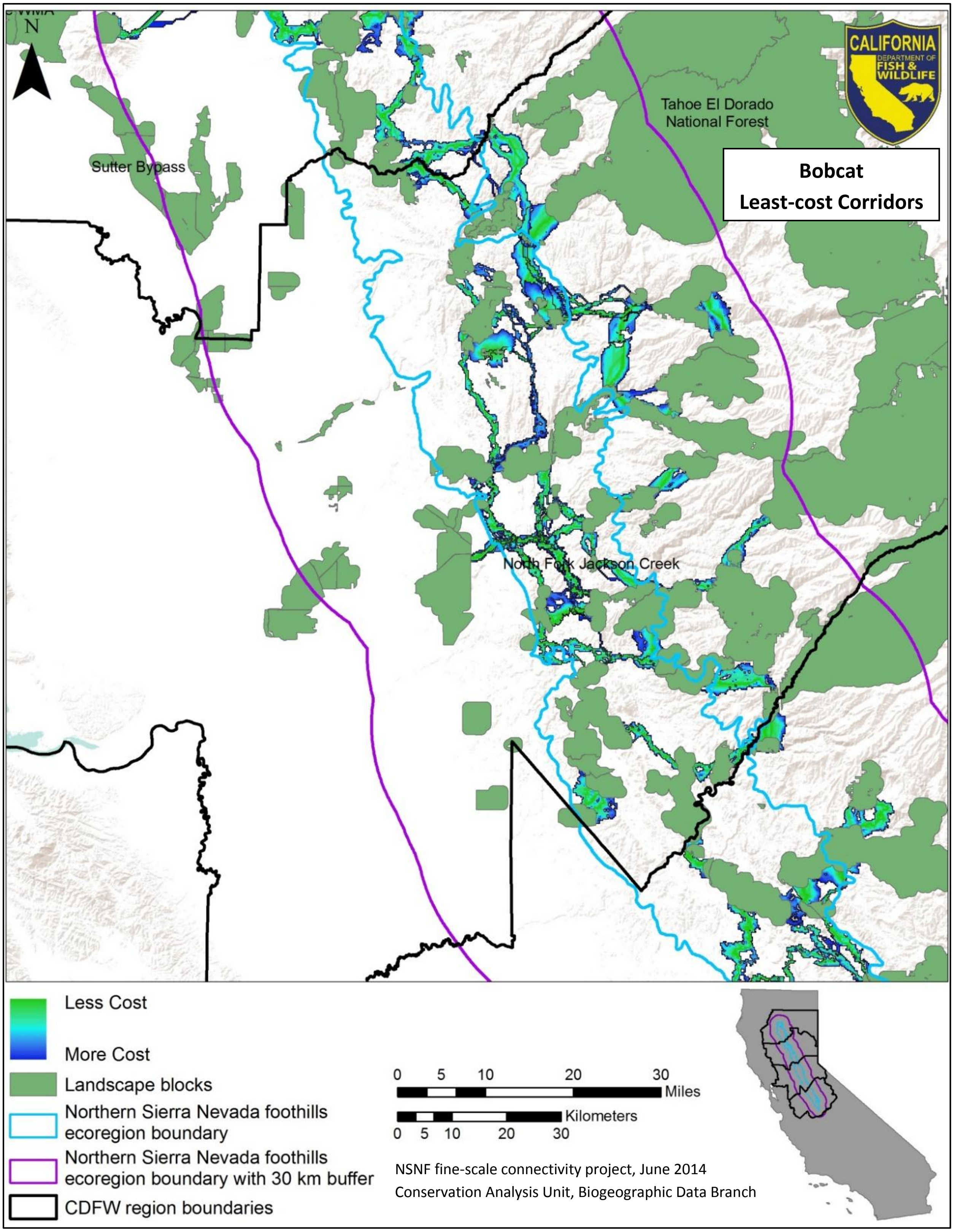


Figure S-22. Least-cost corridor analysis for the bobcat (*Lynx rufus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

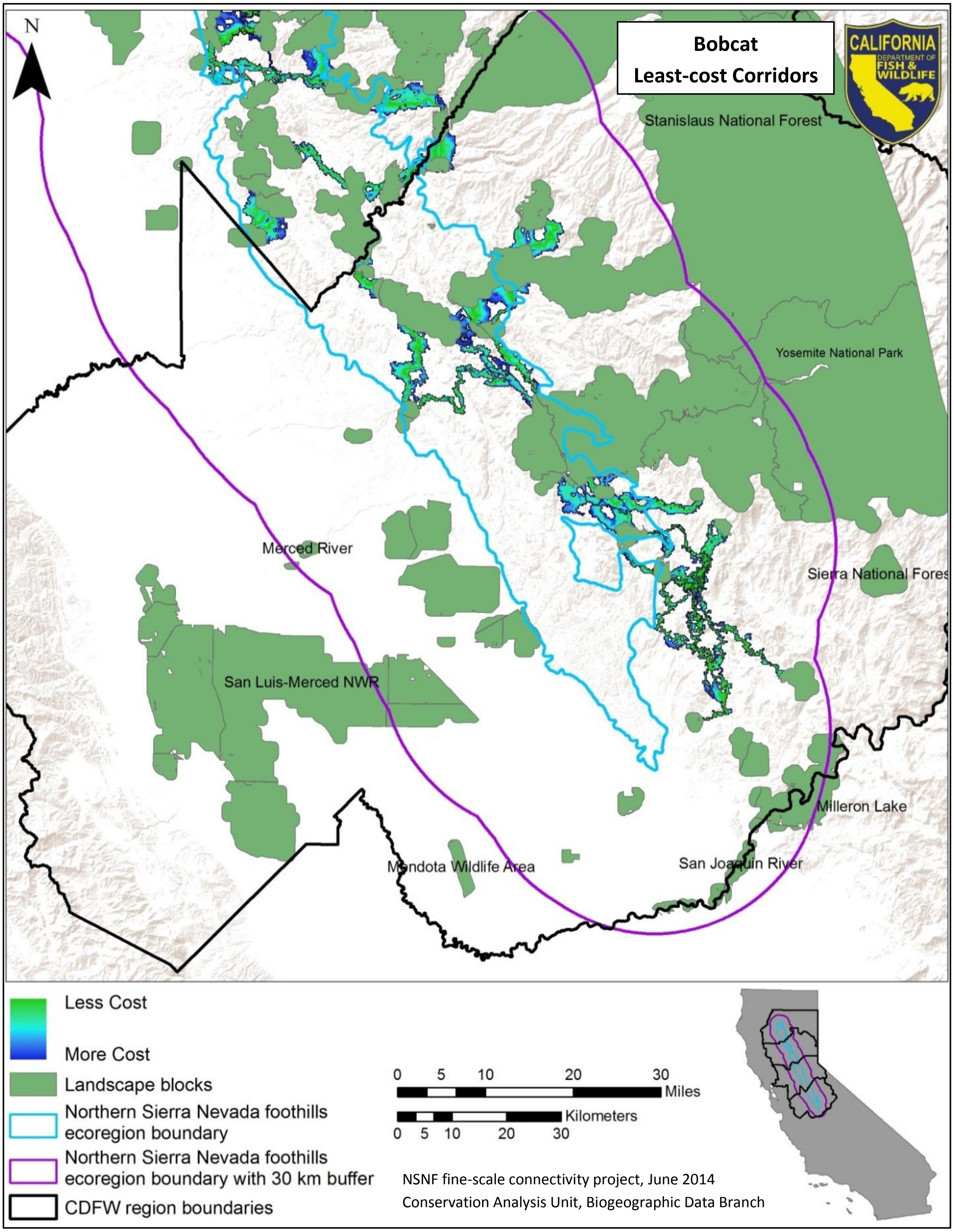


Figure S-23. Least-cost corridor analysis for the bobcat (*Lynx rufus*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

California ground squirrel (*Spermophilus beecheyi*)

Focal species selection: California ground squirrels are a very common permanent resident throughout California. This ground squirrel commonly uses openings and disturbed areas, particularly along roadsides, in croplands and grazed meadows (CWHR 2008). The species occurs from sea level to about 3333 m in elevation (CWHR 2008). This ground squirrel lives in burrows excavated in friable soils where burrow system can be elaborate (CWHR 2008). Little water is required (CWHR 2008). California ground squirrels are important prey for many carnivores, and as such they are an important **corridor dweller** species.

Habitat Model: The final three habitat suitability models developed for California ground squirrel were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 573 location points to train each model, 144 to test each model, and 9833 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: The species is non-migratory with home ranges of usually less than a 137 m radius around burrows (CWHR 2008). In California, home ranges of males averaged 0.1 ha with females averaging 0.2 ha (Evans and Holdenried 1943). Individual home ranges often overlap considerably (CWHR 2008). Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: Average dispersal distance used was 250 m (Van Vuren 1998).

Results and Discussion: The selected California ground squirrel habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.57. The model predicted 4,352,334.1 ha of suitable habitat. The patch analysis identified 79 breeding patches covering 787.1 ha and 180 population patches covering 3,944,661.9 ha. Two hundred twenty-one of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 96.9% of the total corridor area. California ground squirrel habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 34.4% of habitat area in the corridors had high predicted suitability, 33.5% medium and 32.1% low.

Potential habitat for the California ground squirrel is widespread throughout the study area.

Region 1: Most habitat patches are continuous throughout the northern region and captured by most linkages.

Region 2 North: Habitat patches in the foothills and western side of the study area are fairly continuous and are captured by most linkages. Habitat patches on the eastern side of the study area near Round Mountain and the Tahoe-El Dorado NF blocks are isolated from the main foothills landscape blocks.

Region 2 South: Habitat patches are fairly continuous throughout this region of the study area and are captured by most linkages. Habitat patches on the western side near the Cosumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek.

Region 4: Habitat patches are continuous throughout the southern region and captured by most linkages.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.57	n/a	4,352,334.1	3,945,449	259

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
40.2	22.4	37.4

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
221	96.9	32.1	33.5	34.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
30.8	57.7	35.5	38.5

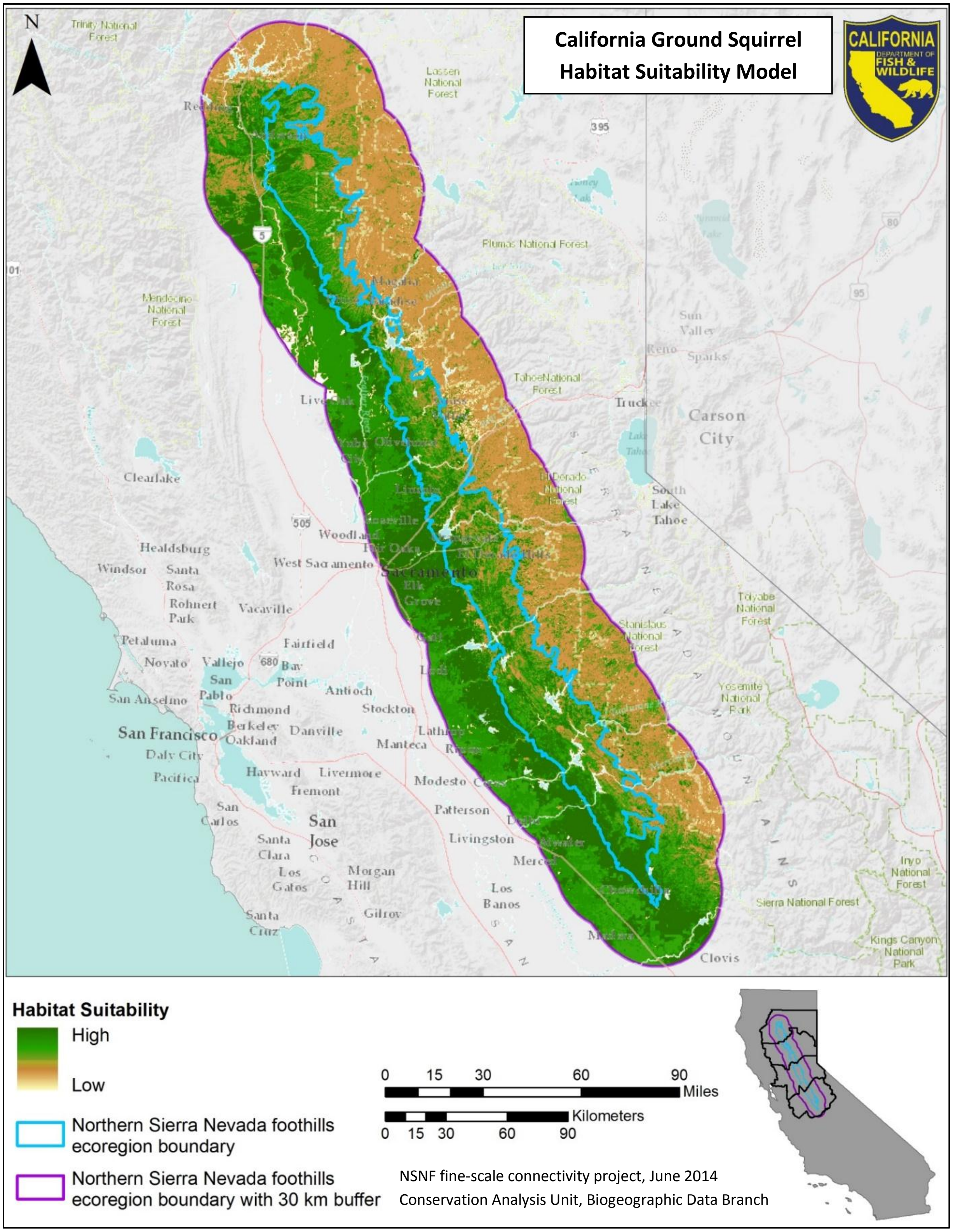


Figure S-24. Predicted habitat suitability for the California ground squirrel (*Spermophilus beecheyi*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes**.**

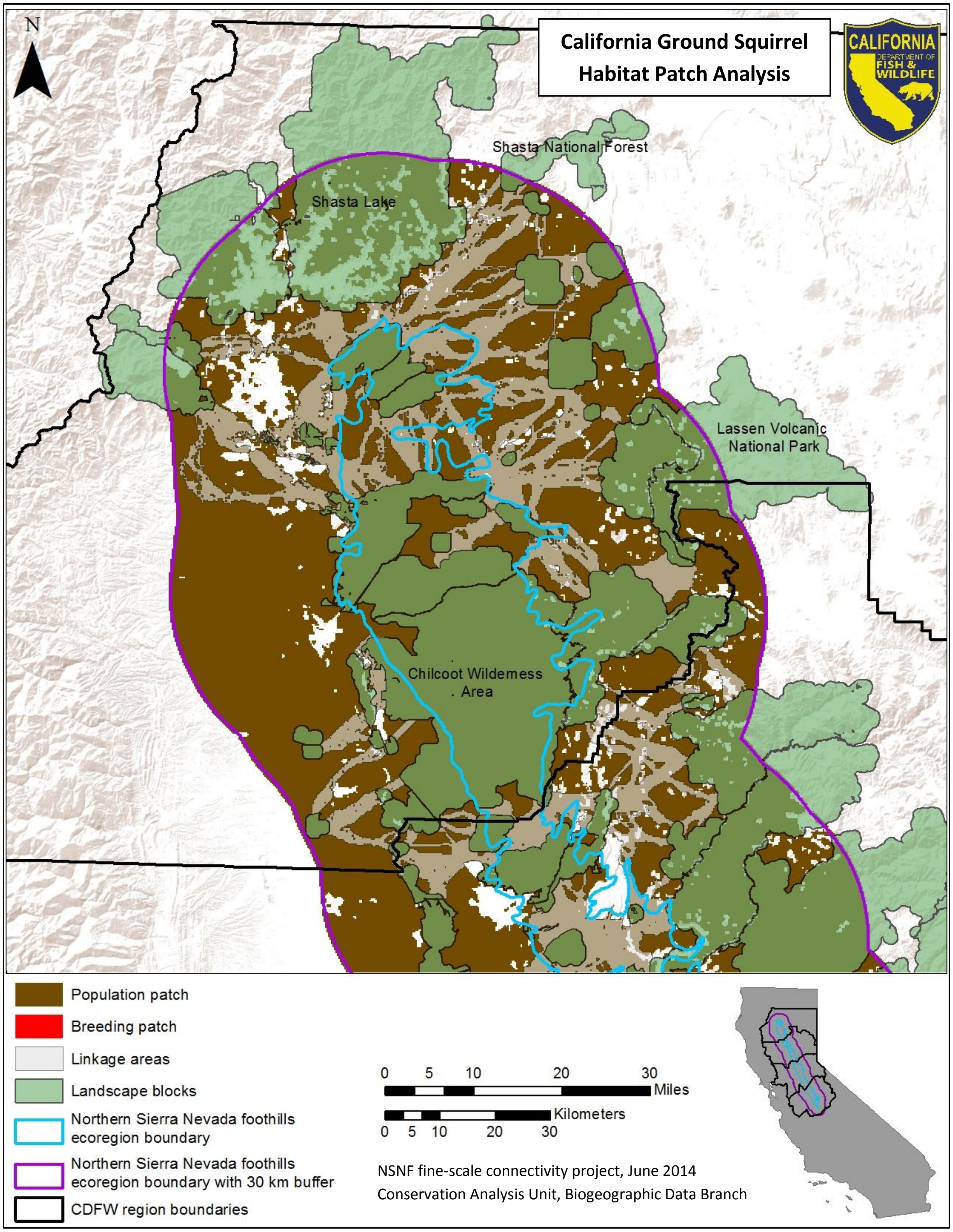


Figure S-25. Habitat patch analysis for the California ground squirrel (*Spermophilus beecheyi*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

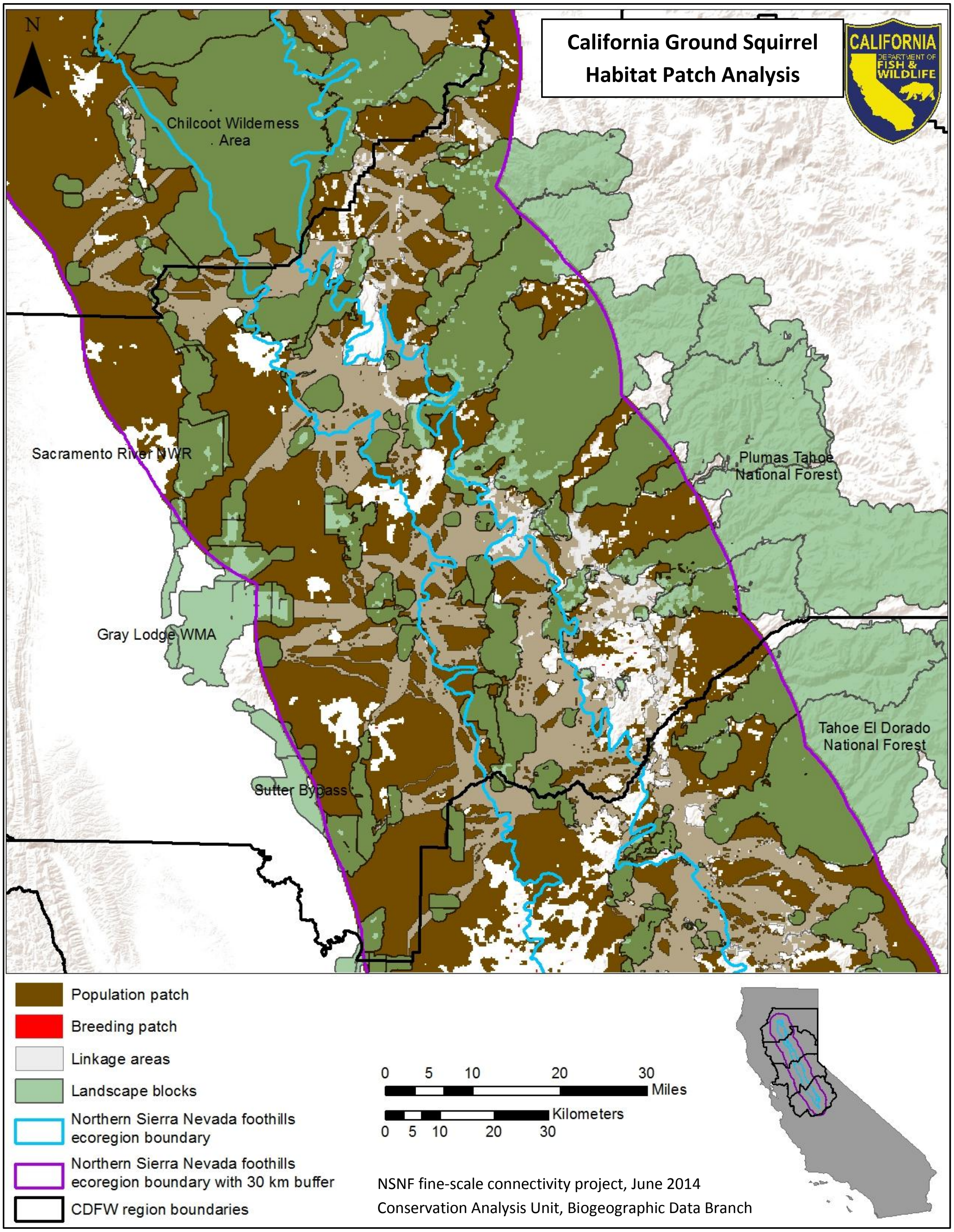


Figure S-26. Habitat patch analysis for the California ground squirrel (*Spermophilus beecheyi*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

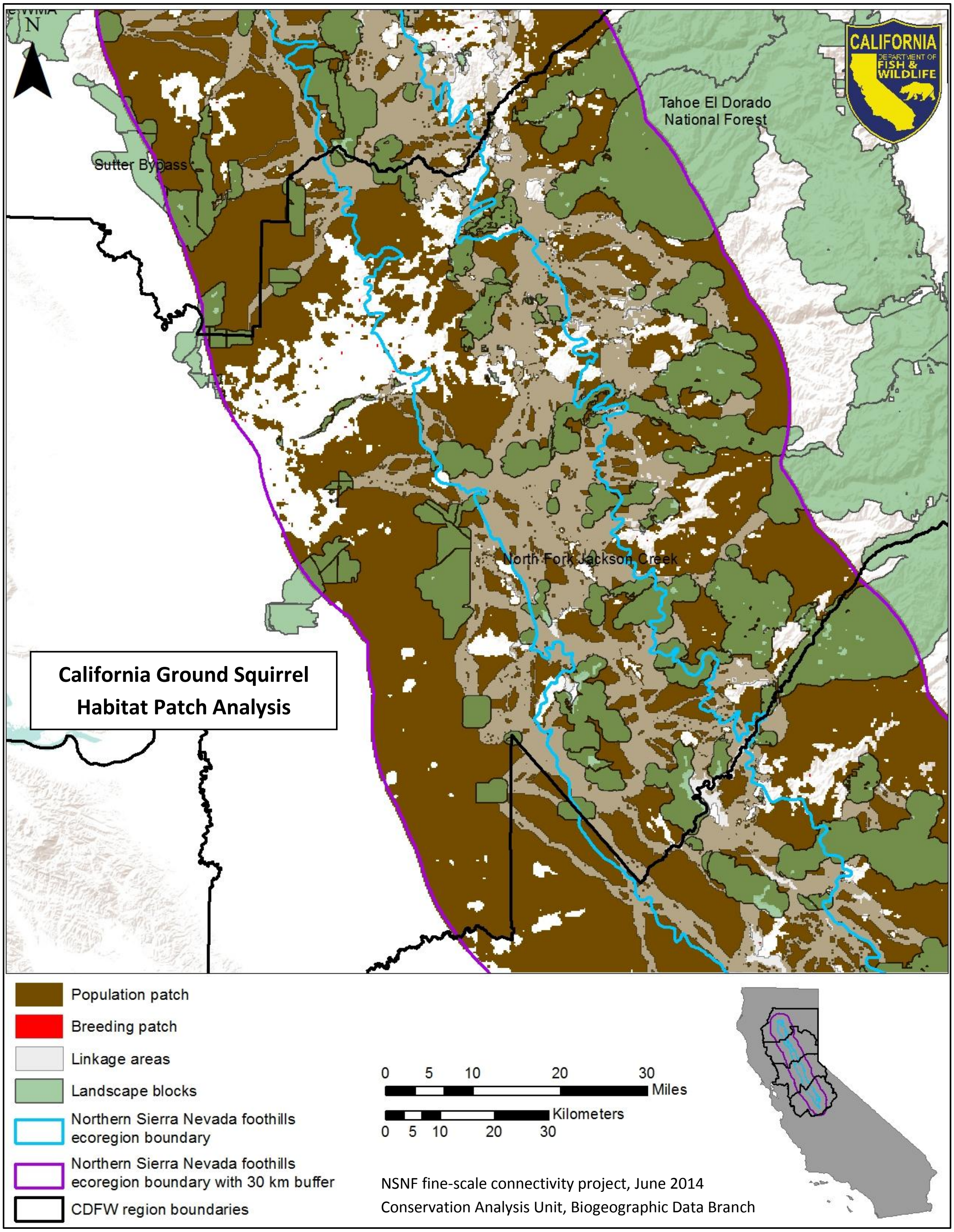


Figure S-27. Habitat patch analysis for the California ground squirrel (*Spermophilus beecheyi*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

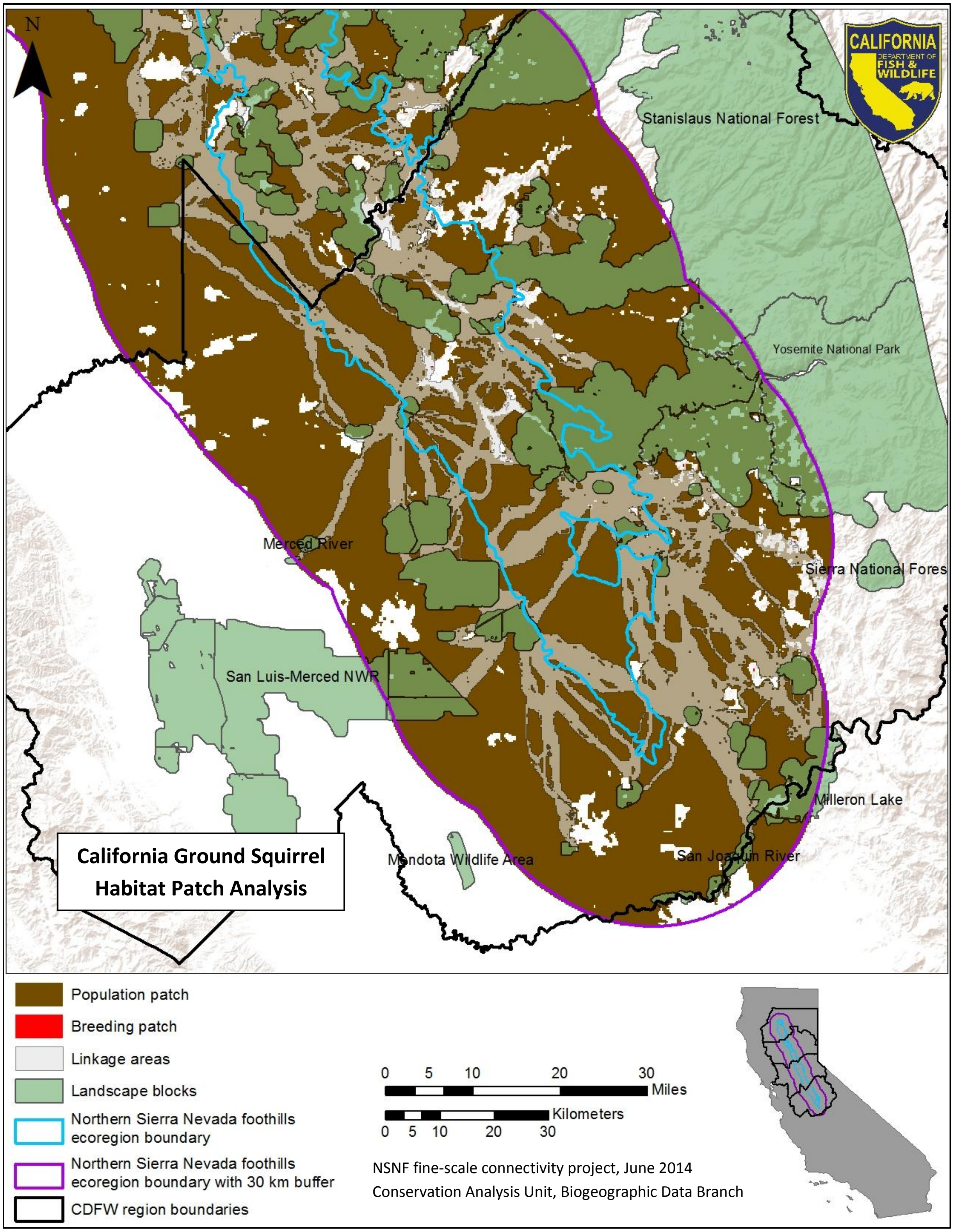


Figure S-28. Habitat patch analysis for the California ground squirrel (*Spermophilus beecheyi*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

California kangaroo rat (*Dipodomys californicus*)

Focal species selection: The California kangaroo rat occurs in the foothills from El Dorado County north to Oregon border. It inhabits open areas, generally below 400 m elevation (CWHR 2008). The species is usually found in annual grassland habitat, but also occurs in clearings in mixed chaparral habitat on the lower slopes of the foothills (Verner and Boss 1980). It can also be found in valley foothill hardwood, and to a lesser extent in valley foothill hardwood-conifer habitats (CWHR 2008). The species lives in burrows excavated in loose soils, often at base of shrubs or edges of rocks (CWHR 2008). Water is apparently obtained metabolically from food (CWHR 2008). The California kangaroo rat was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for California kangaroo rat were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 164 location points to train each model, 41 to test each model, and 9945 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: California kangaroo rats are aggressively solitary animals (CWHR 2008). No information on home range or territory size was found. Minimum breeding patch size used was 1 ha; minimum population patch size was 8 ha.

Dispersal/Migration: Average dispersal distance used was 250 m (Van Vuren 1998).

Results and Discussion: The selected California kangaroo rat habitat suitability model was the Maxent scenario 5. The model performed well with an AUC of 0.96. The mean probability threshold was 0.10 predicting 896,035.8 ha of suitable habitat. The patch analysis identified 36 breeding patches covering 2,310.7 ha and 25 population patches covering 627,598.6 ha. Twenty-seven of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 79.6% of the total corridor area. California kangaroo rat habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 17.4% of habitat area in the corridors had high predicted habitat suitability, 36.7% medium and 45.9% low.

Potential habitat for the California kangaroo rat is limited to the western foothills and western side of the study area, from El Dorado County north.

Region 1: Most habitat patches are continuous on the western side of the study area. The linkages capture most of the habitat patches in the north between Chilcoot WA and Shasta Lake.

Region 2 North: Habitat is limited to the western side of the foothills in this region of the study area. Habitat patches on the western side near the Sutter Buttes are isolated from the main foothills blocks. In the foothills habitat patches are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the very north of this subsection. Isolated patches of habitat occur between Spenceville WMA and Morman Hill-South Fork American River blocks.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.96	0.10	896,035.8	630,223.0	95

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
56.7	27.5	15.8

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
27	79.6	45.9	36.7	17.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
13.6	22.4	18.4	16.8

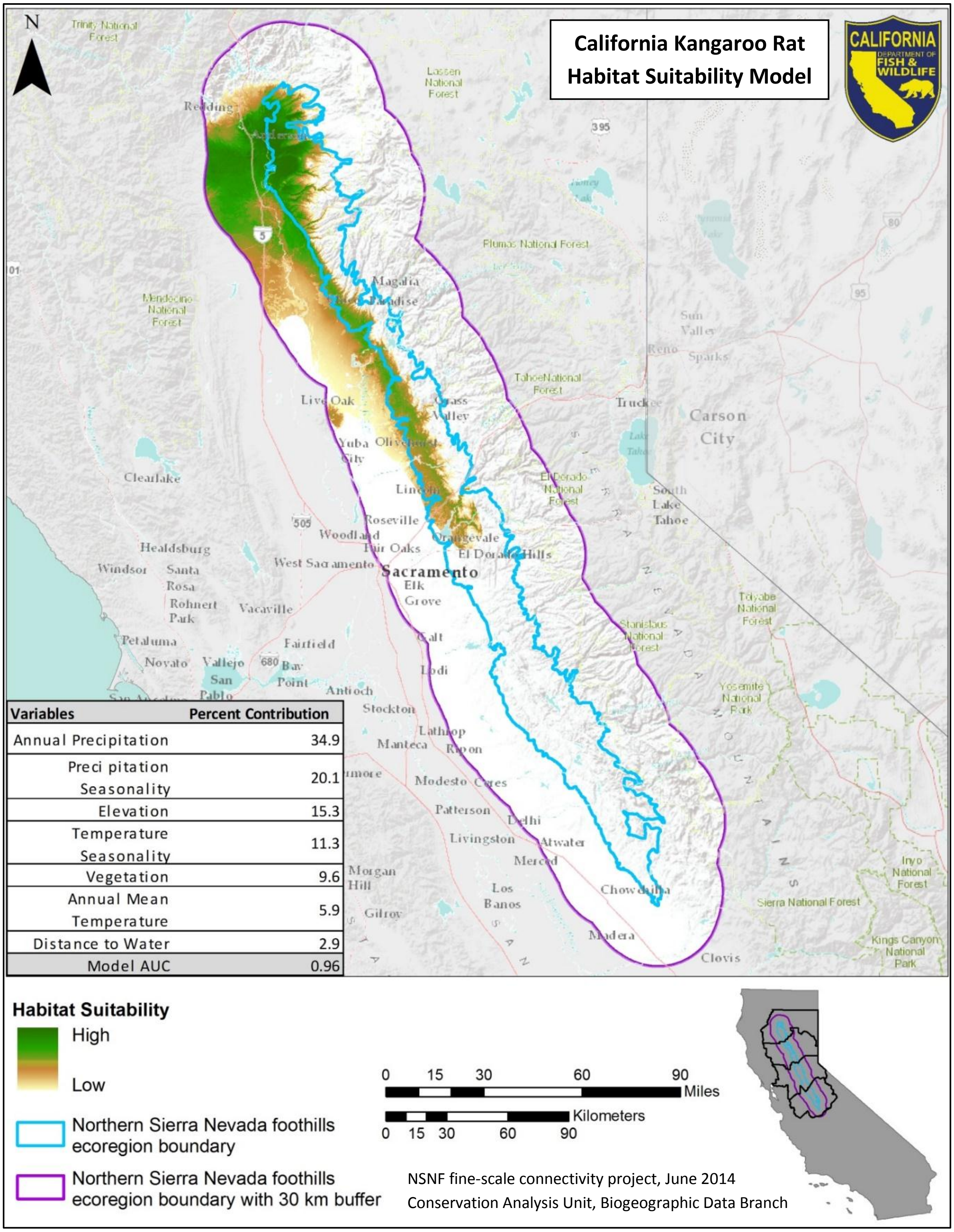


Figure S-29. Predicted habitat suitability for the California kangaroo rat (*Dipodomys californicus*). Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer.

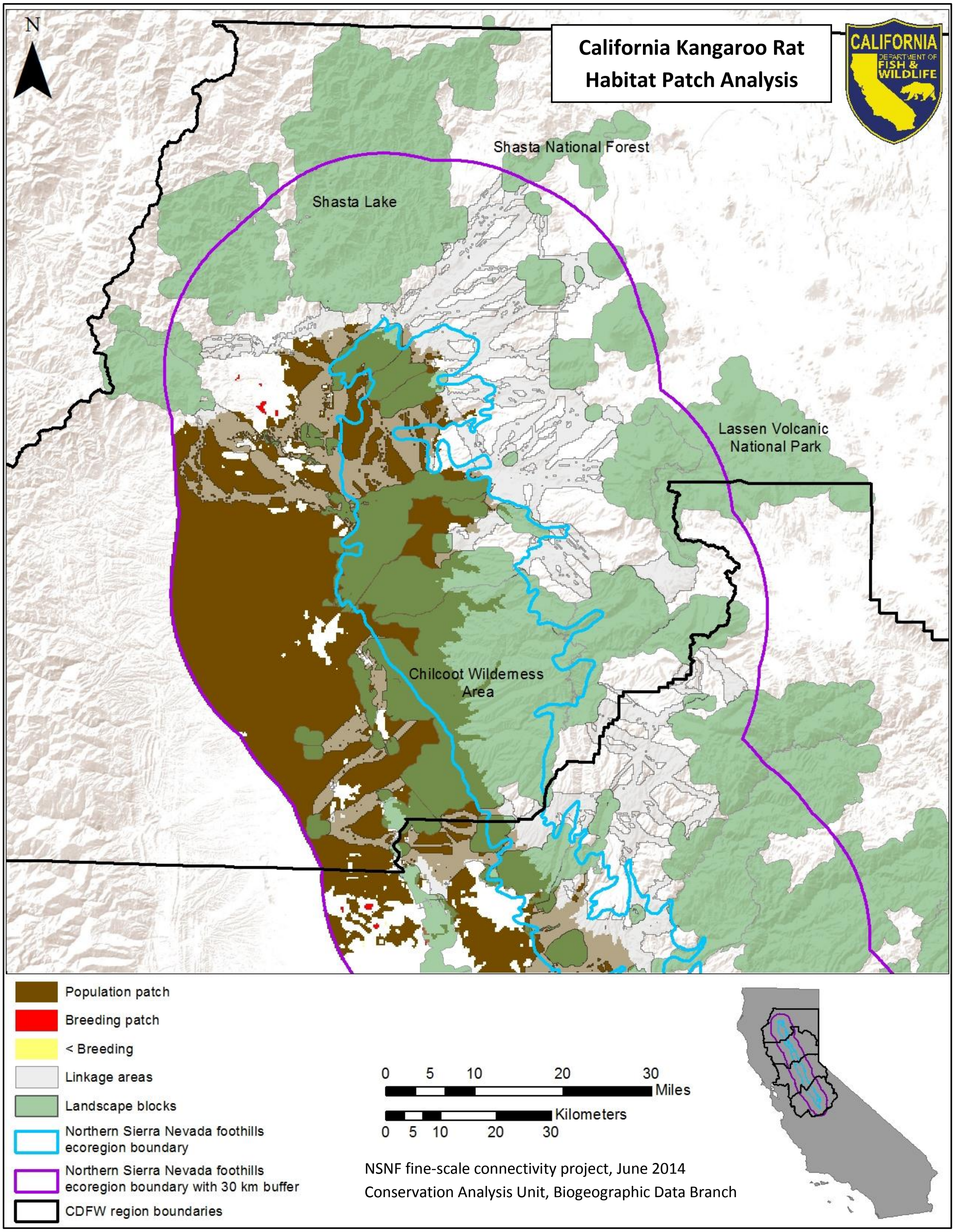


Figure S-30. Habitat patch analysis for the California kangaroo rat (*Dipodomys californicus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >8 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

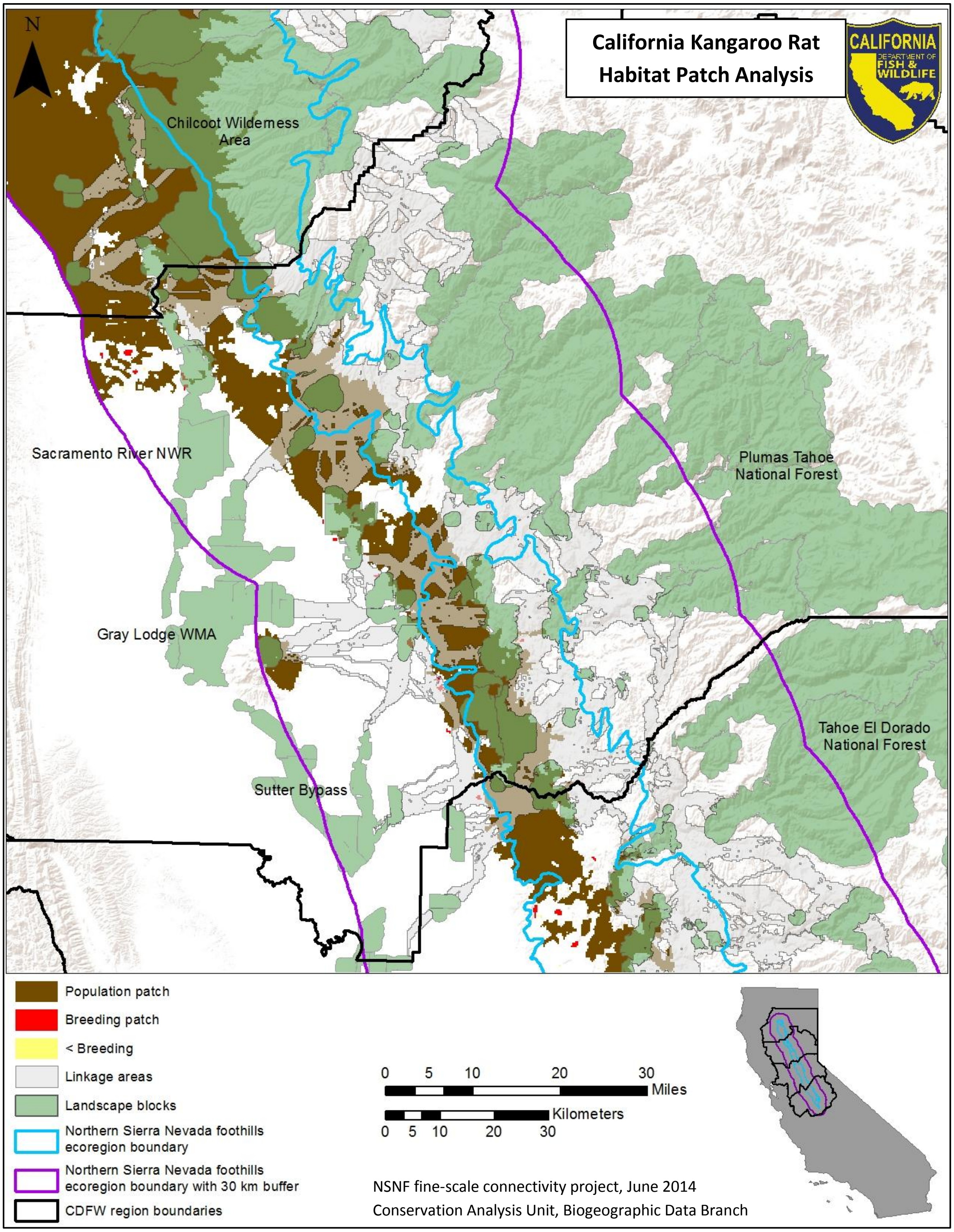


Figure S-31. Habitat patch analysis for the California kangaroo rat (*Dipodomys californicus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >8 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

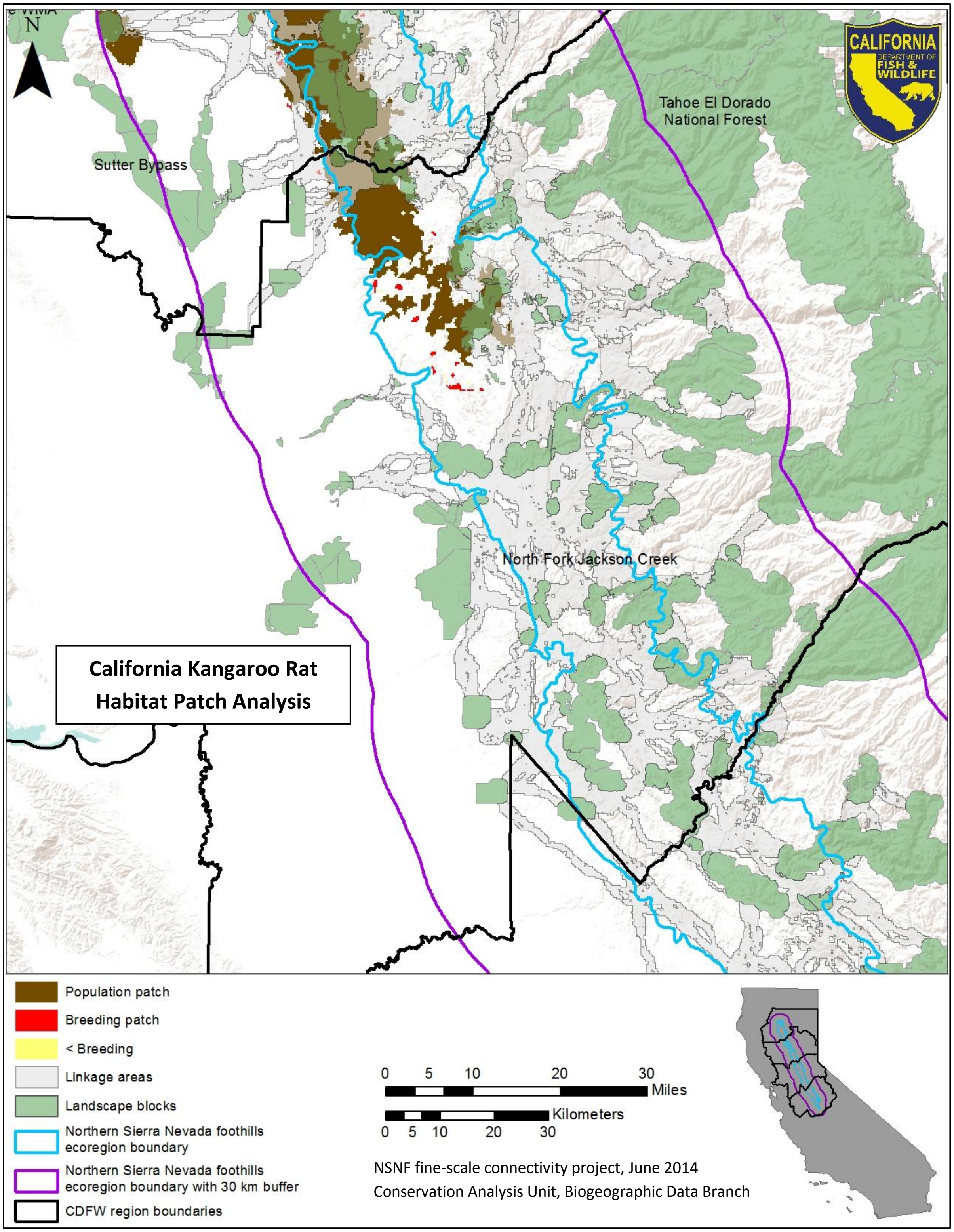


Figure S-32. Habitat patch analysis for the California kangaroo rat (*Dipodomys californicus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >8 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

California quail (*Callipepla californicus*)

Focal species selection: California quail are common permanent residents of low and middle elevations the length of California (CWHR 2008). The species requires a mosaic of low, brushy vegetation with grass/forb openings, taller shrubs, trees and interspersed with water (CWHR 2008). In cool weather, California quail probably meets its water needs from succulent plants, arthropods and dew, but in hot weather it requires free water daily (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the California quail was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for California quail were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 8564 location points to train each model, 2141 to test each model, and 17812 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: In California, winter range of 4 coveys averaged 10.5 ha before incubation and 1.2 to 4 ha during incubation (CWHR 2008). Broods used only a few acres the first 2 weeks and 4-8 ha by 1 month. Occasionally a brood moved 1.6 km from nest to brood range. In nesting season, unmated individuals may wander. Territory includes the immediate vicinity of female; unmated males may establish a calling territory adjacent to a breeding pair. Minimum breeding patch size used was 4 ha; minimum population patch size was 500 ha.

Dispersal/Migration: Non migratory, winter movement usually encompasses twice the area used in summer. Coveys may disperse in spring up to 8 km (CWHR 2008) and dispersal of up to 17 km has been recorded (Richardson 1941). We used a maximum dispersal distance of 17 km.

Results and Results: The selected California quail habitat suitability model was Maxent scenario 5. The model performed well with an AUC of 0.75. The mean probability threshold was 0.29 predicting 4,015,346 ha of suitable habitat. The patch analysis identified 269 breeding patches covering 14,054.58 ha and 49 population patches covering 3,677,976.6 ha. Two hundred forty-four of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 96.4% of the total corridor area. California quail habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 8.8% of habitat area in the corridors had high predicted habitat suitability, 72% medium and 19.2% low.

Potential habitat for the California quail is widespread throughout the foothills and western side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with an isolated patch on the eastern side south of Lassen Volcanic National Park. The linkages capture most of the habitat patches in this region.

Region 2 North: Habitat patches are continuous throughout this region of the study area and are captured by most linkages.

Region 2 South: Habitat patches are fairly continuous throughout this region of the study area; urban areas near Sacramento are the exception. Habitat patches are captured by most linkages.

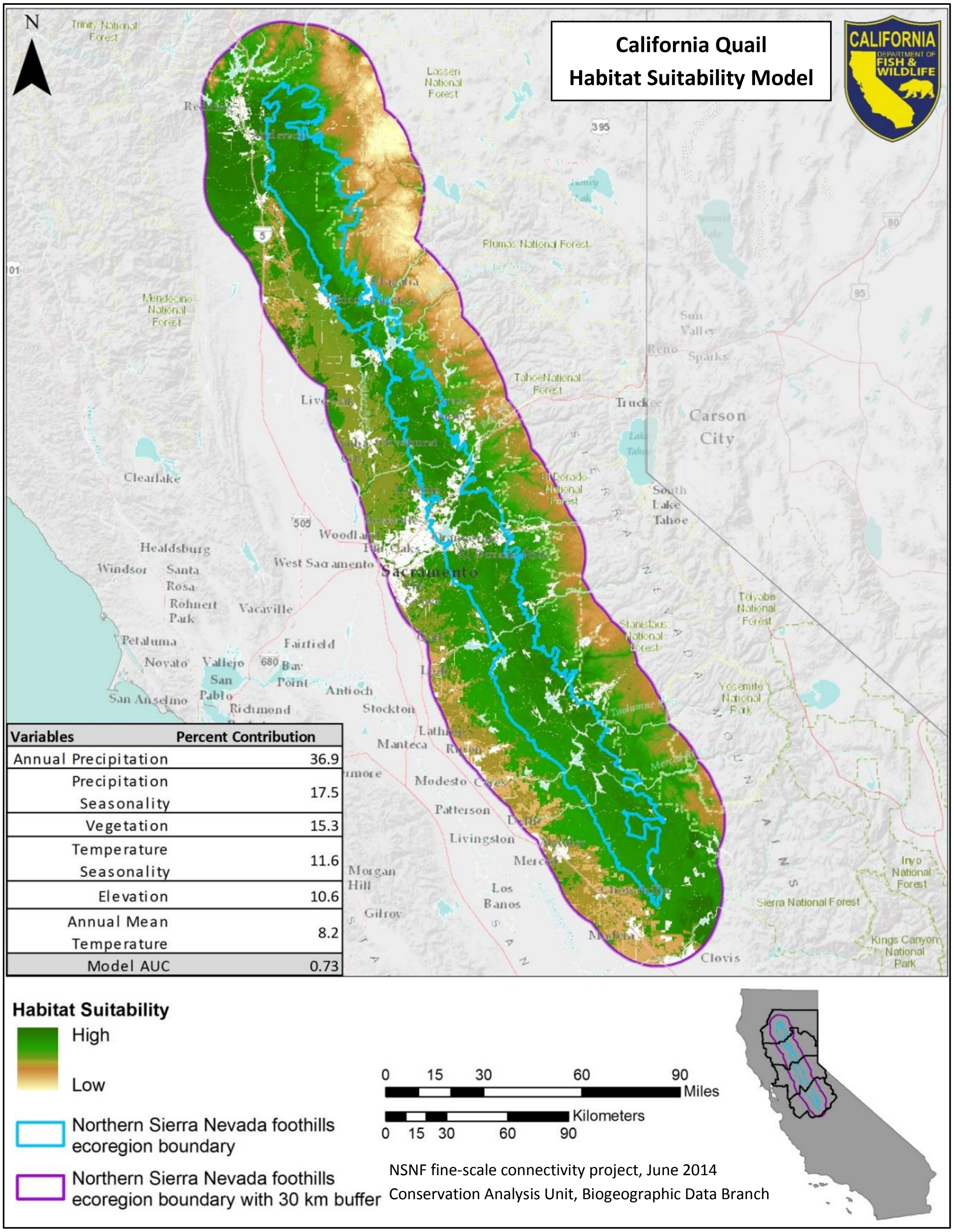
Region 4: Habitat patches are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.75	0.29	4,015.346.6	3,692,031.5	318

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
43.6	49.0	7.4

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
244	96.4	19.2	72	8.8

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
19.6	65.5	53.4	44.6



Variables	Percent Contribution
Annual Precipitation	36.9
Precipitation Seasonality	17.5
Vegetation	15.3
Temperature Seasonality	11.6
Elevation	10.6
Annual Mean Temperature	8.2
Model AUC	0.73

Figure S-33. Predicted habitat suitability for the California quail (*Callipepla californicus*). Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer

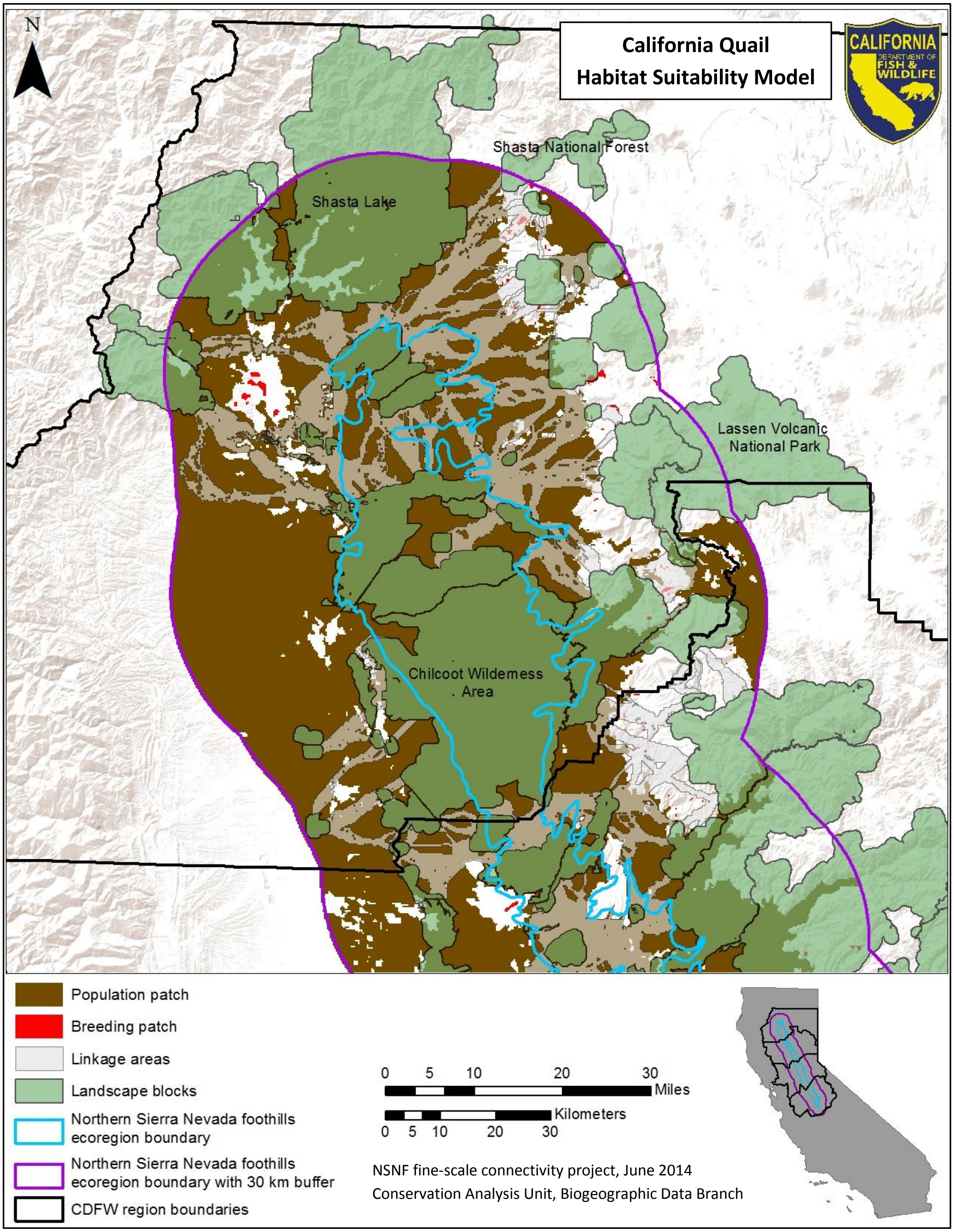


Figure S-34. Habitat patch analysis for the California quail (*Callipepla californicus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

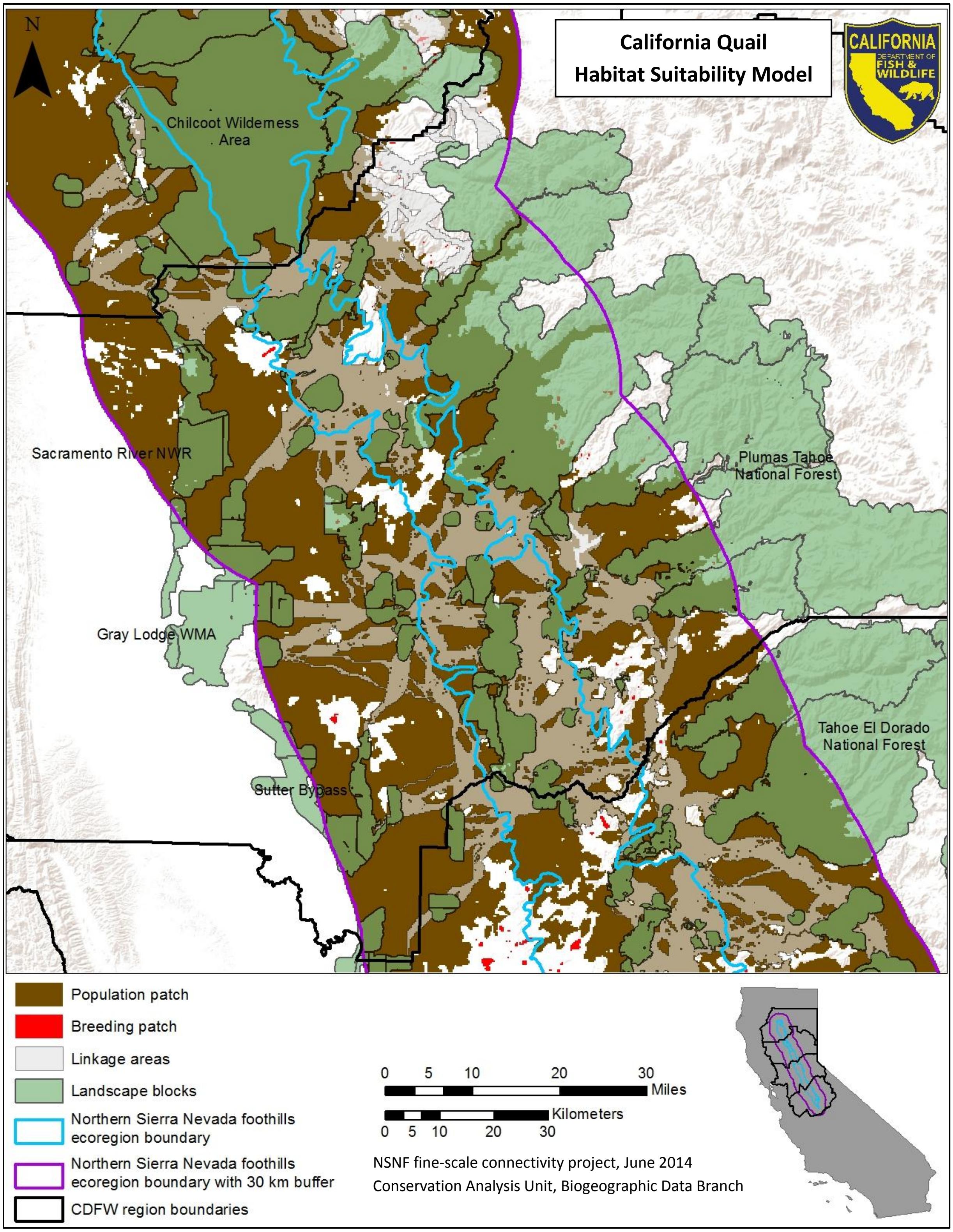


Figure S-35. Habitat patch analysis for the California quail (*Callipepla californicus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

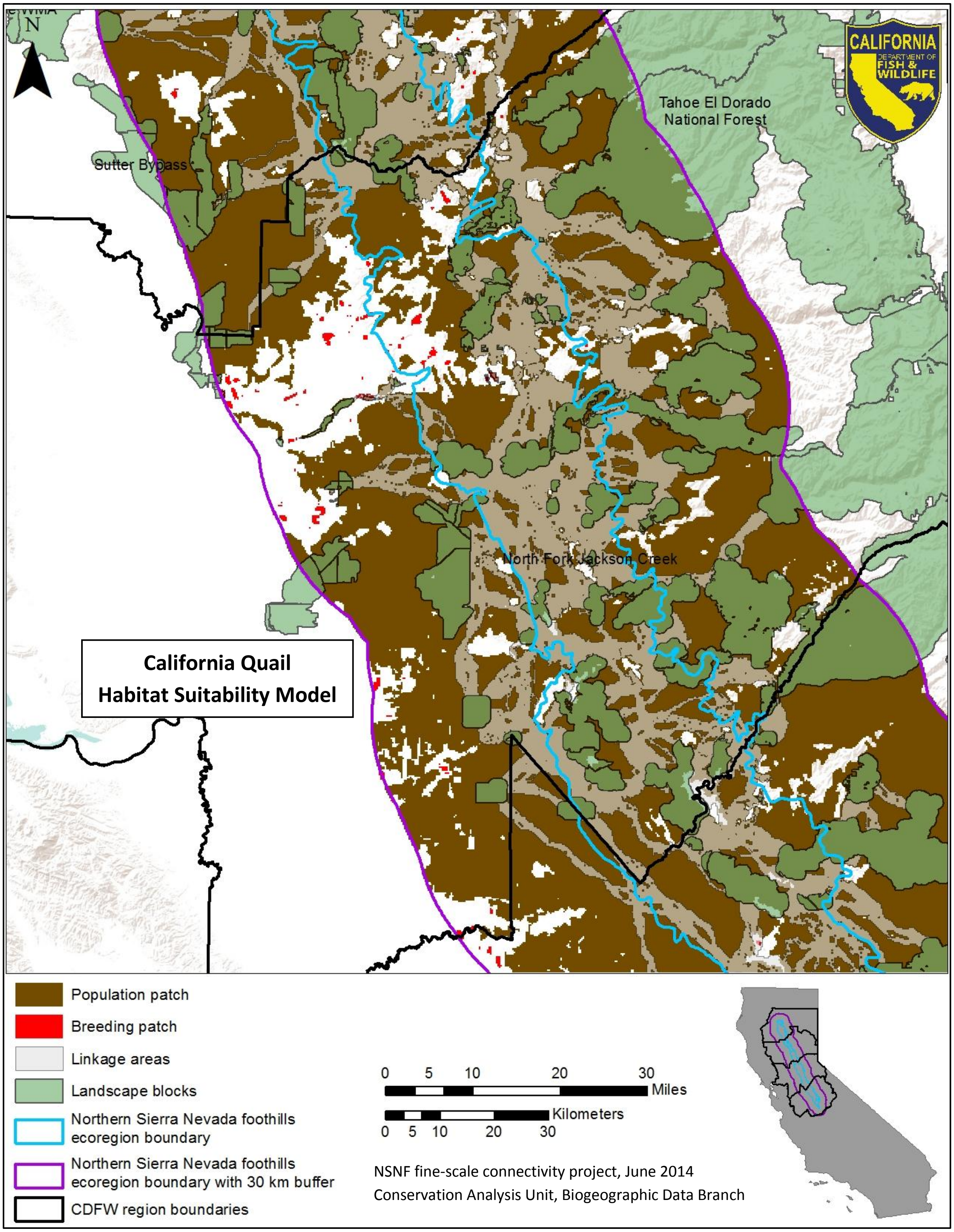


Figure S-36. Habitat patch analysis for the California quail (*Callipepla californicus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

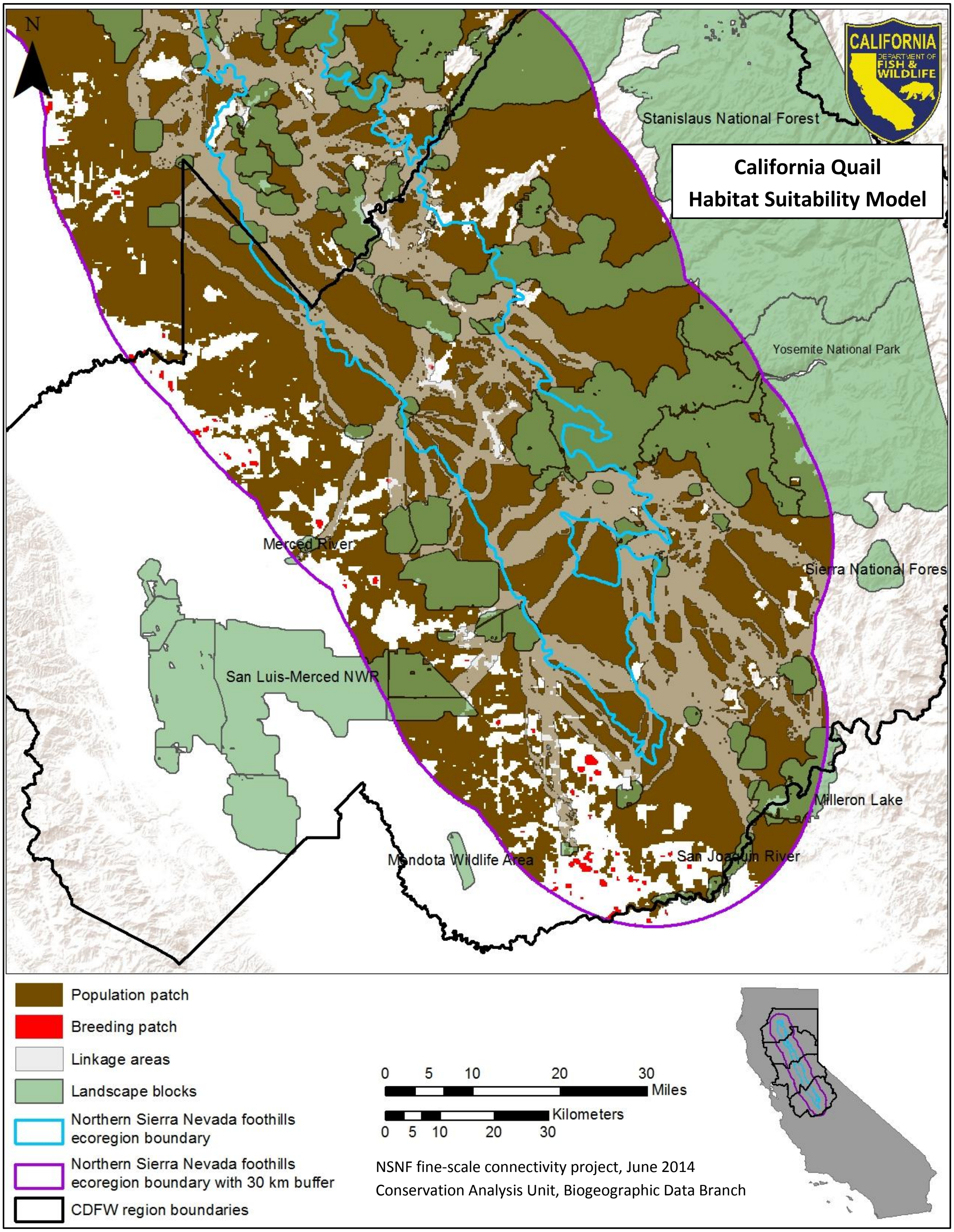


Figure S-37. Habitat patch analysis for the California quail (*Callipepla californicus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

California thrasher (*Toxostoma redivivum*)

Focal species selection: California thrasher are common residents of the foothills that occupy moderate to dense chaparral habitats and less commonly extensive thickets in young or open valley foothill riparian habitat (CWHR 2008). The species builds nests well inside large shrubs or scrubby trees, usually 0.6 to 1.5 m above ground (CWHR 2008). It apparently meets water requirements from food (CWHR 2008). California thrashers are habitat specialists and are sensitive to habitat loss; they are among the first species to disappear (Soule, Bolger et al. 1988). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the California thrasher was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for California thrasher were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 2733 location points to train each model, 684 to test each model, and 9290 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Average territory in chaparral habitat was 1.4 ha (Kingery 1978). Minimum breeding patch size used was 3 ha; minimum population patch size was 300 ha.

Dispersal/Migration: The species is a non-migratory, mostly sedentary resident. It has very limited dispersal, usually only a few kilometers, with rare dispersal events of 40 to 65 km (Cody 2012). Maximum dispersal distance used was 65 km.

Results and Results: The selected California thrasher habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.79. The mean probability threshold was 0.29, predicting 2,979,167.9 ha of suitable habitat. The patch analysis identified 1,610 breeding patches covering 70,281.3 ha, and 268 population patches covering 1,985,773.1 ha. Two hundred thirty-five of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 76.1% of the total corridor area. California thrasher habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 34.3% of habitat area in corridors had high predicted suitability, 50.2% medium and 15.4% low.

Potential habitat for the California thrasher is widespread throughout the foothills of the study area.

Region 1: Most habitat patches are continuous throughout the foothills and eastern side of the study area. Habitat patches on the eastern side of the study area are scattered but within California thrashers dispersal distance. The linkages capture most of the habitat patches in the north between Chilcoot WA and Shasta Lake.

Region 2 North: Habitat is continuous throughout the foothills and limited on eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Sacramento River NWR and Gray Lodge WMA are captured fairly well in linkages to blocks in the foothills. Habitat patches in the foothills are fairly continuous and are captured by most linkages. Habitat patches on the eastern side are scattered among the landscape blocks.

Region 2 South: Habitat is limited to the foothills and western side in this region with only scattered patches on the eastern side of the study area. Habitat patches on the western side near the Consumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills are fairly continuous and are captured by most linkages.

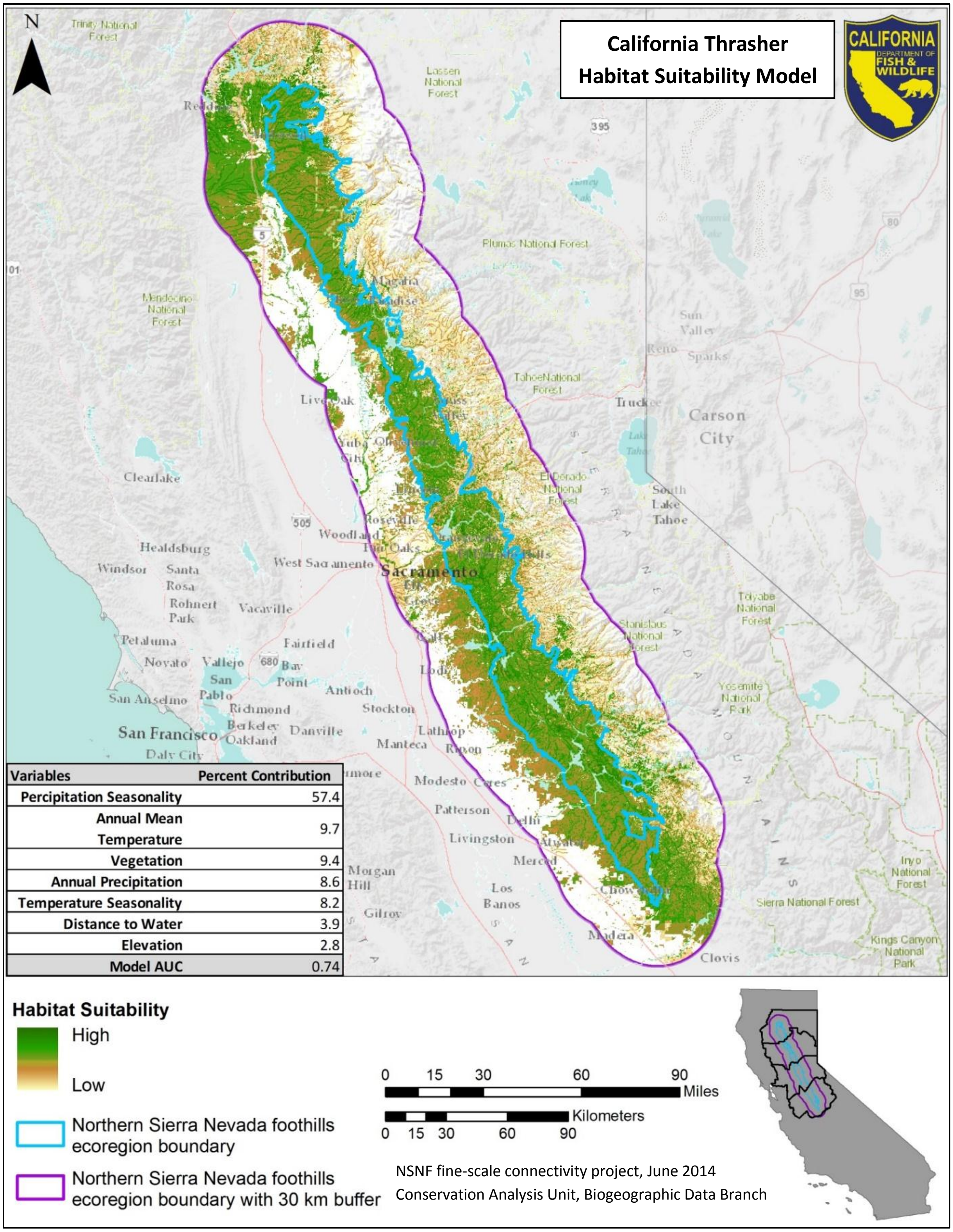
Region 4: Habitat patches are fairly continuous and are captured by most linkages. There are a few isolated habitat patches on the eastern side between Stanislaus National Forest and the main foothill blocks.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.79	0.29	2,979,167.9	2,056,054.8	1,878

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
26.4	50.5	23.1

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
235	76.1	15.4	50.2	34.3

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
30.0	51.0	76.2	51.3



Variables	Percent Contribution
Percipitation Seasonality	57.4
Annual Mean Temperature	9.7
Vegetation	9.4
Annual Precipitation	8.6
Temperature Seasonality	8.2
Distance to Water	3.9
Elevation	2.8
Model AUC	0.74

Figure S-38. Predicted habitat suitability for the California thrasher (*Toxostoma redivivum*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

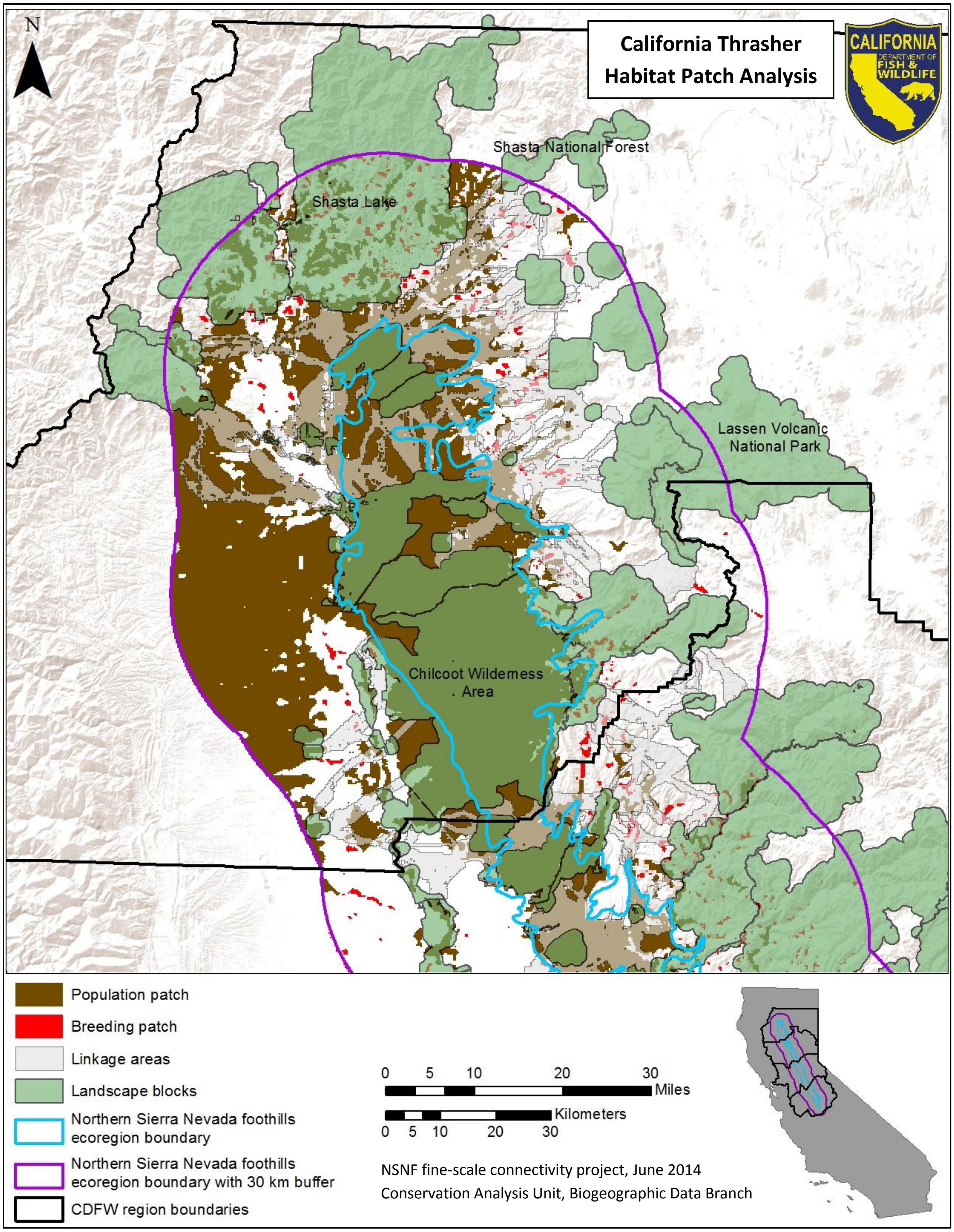


Figure S-39. Habitat patch analysis for the California thrasher (*Toxostoma redivivum*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >300 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

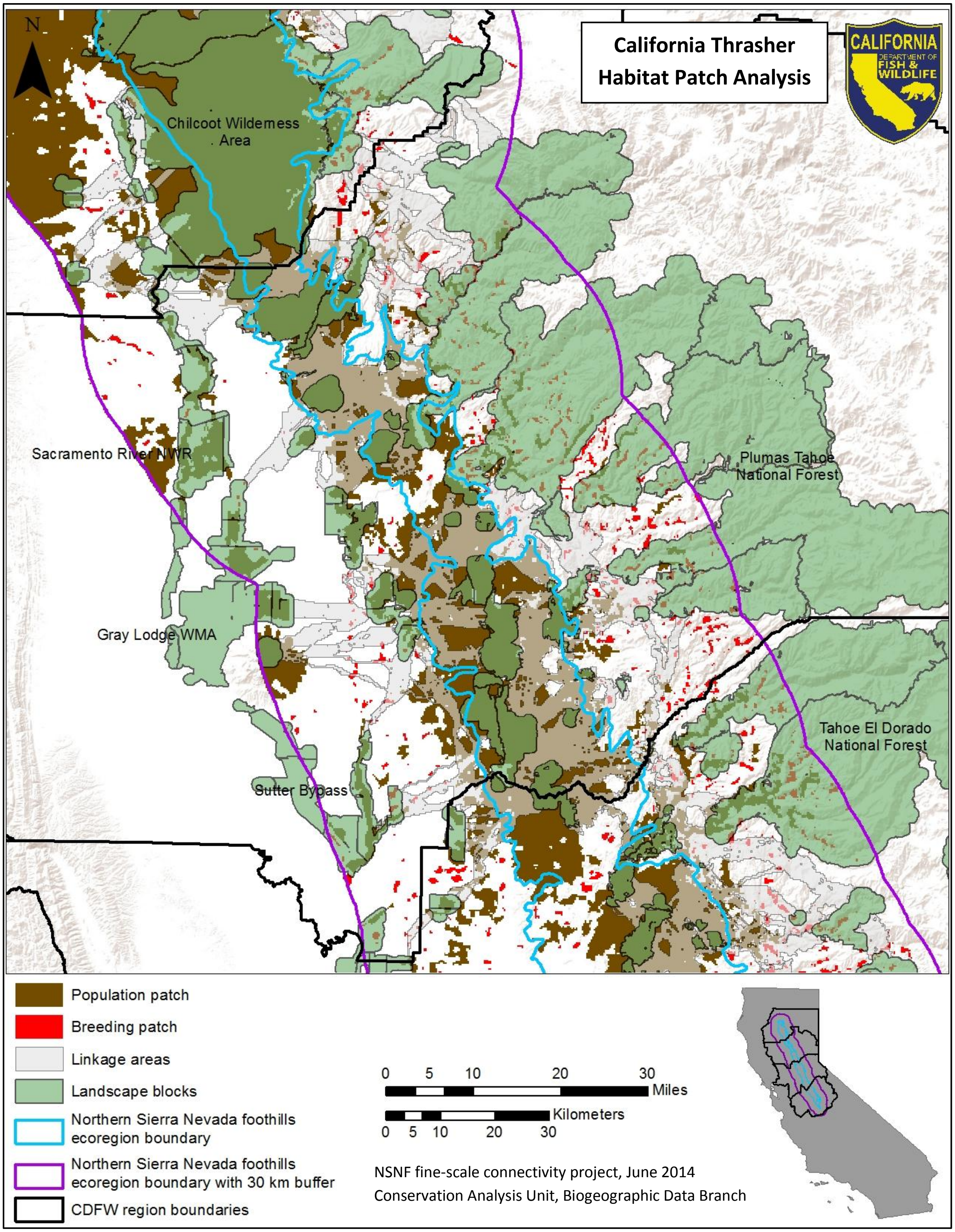


Figure S-40. Habitat patch analysis for the California thrasher (*Toxostoma redivivum*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >300 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

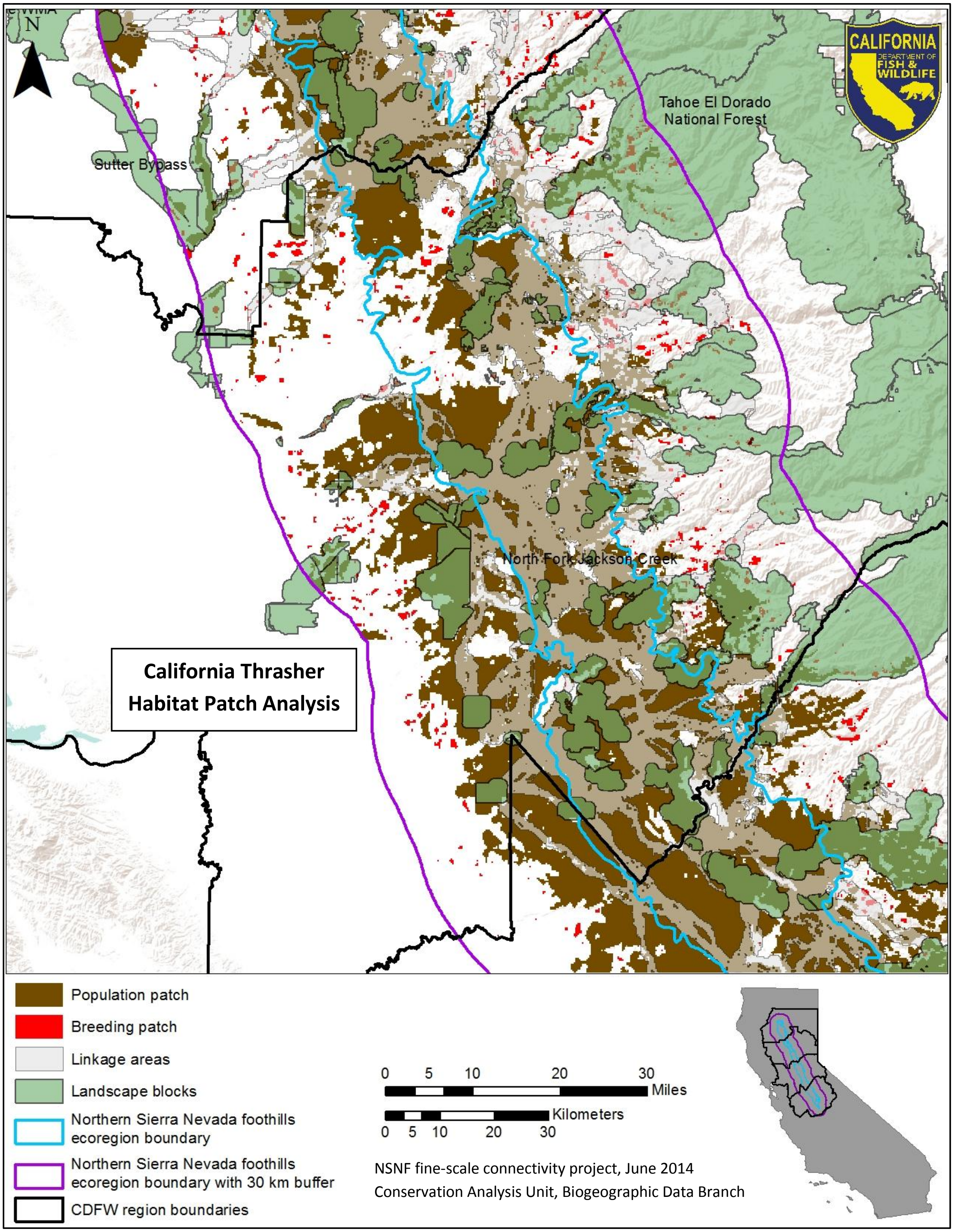


Figure S-41. Habitat patch analysis for the California thrasher (*Toxostoma redivivum*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >300 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

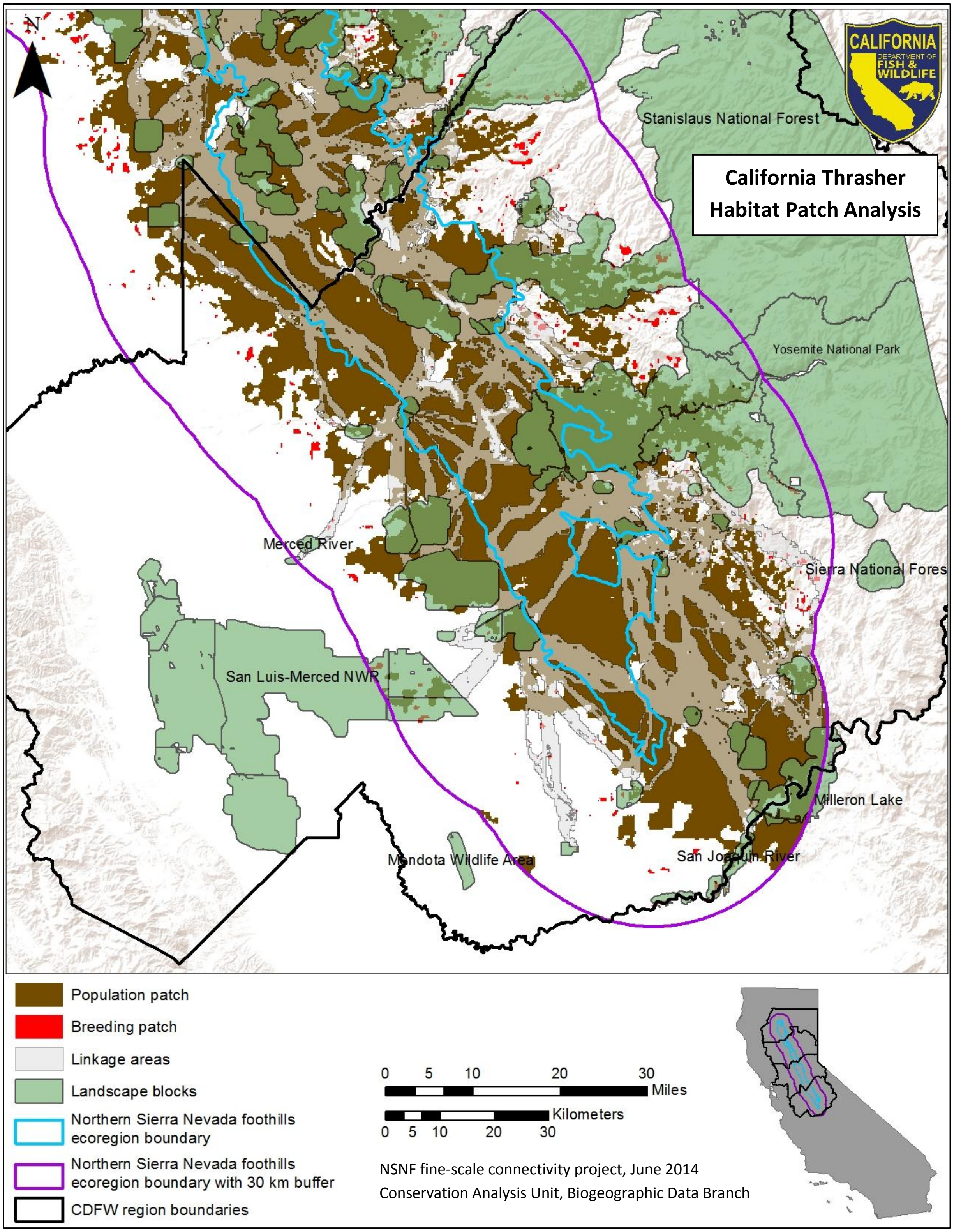


Figure S-42. Habitat patch analysis for the California thrasher (*Toxostoma redivivum*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >300 ha; breeding patches were contiguous areas of suitable habitat >3 ha.

Coast horned lizard (*Phrynosoma coronatum*)

Focal species selection: Coast horned lizards are uncommon to common residents of valley-foothill hardwood, conifer and riparian habitats as well as pine-cypress, juniper and annual grassland habitats. The species is found across the foothills from Butte to Kern County up to 1200 m elevation (CWHR 2008). Coast horned lizards are dependent on ants and other small insects as their food source. The Coast horned lizard was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for Coast horned lizard were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 454 location points to train each model, 113 to test each model, and 9861 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Little is known about the species' home range (CWHR 2008). Minimum breeding patch size used was 20 ha; minimum population patch size was 250 ha (Penrod, Cabanero et al. 2004).

Dispersal/Migration: Coast horned lizard is a non-migratory species, with no seasonal movements documented. Maximum dispersal used was 60 m(Penrod, Cabanero et al. 2004).

Results and Discussion: The selected coast horned lizard habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.81. The mean probability threshold was 0.28, predicting 1,464,320.4 ha of suitable habitat. The patch analysis identified 496 population patches covering 1,098,334.36 ha. Ninety-nine of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 83.3% of the total corridor area. Coast horned lizard habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 24.8% of habitat area in corridors had high predicted suitability, 63.9% medium and 11.3% low.

Potential habitat for the coast horned lizard is limited to the foothills of the study area.

Region 1: Most habitat patches are continuous throughout the foothills of the northern region of the study area. Habitat patches on the western side of the study area near the McClure Creek blocks are isolated from the Chilcoot WA.

Region 2 North: Habitat patches are limited to the foothills of the study area. Habitat patches near Sutter Buttes are isolated from the main foothills.

Region 2 South: Habitat patches in the foothills of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat patches in the foothills of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.81	0.28	1,464,320.4	1,098,334.3	496

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
22.8	59.6	17.6

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
99	83.3	11.3	63.9	24.8

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
23.6	51.1	67.4	47.7

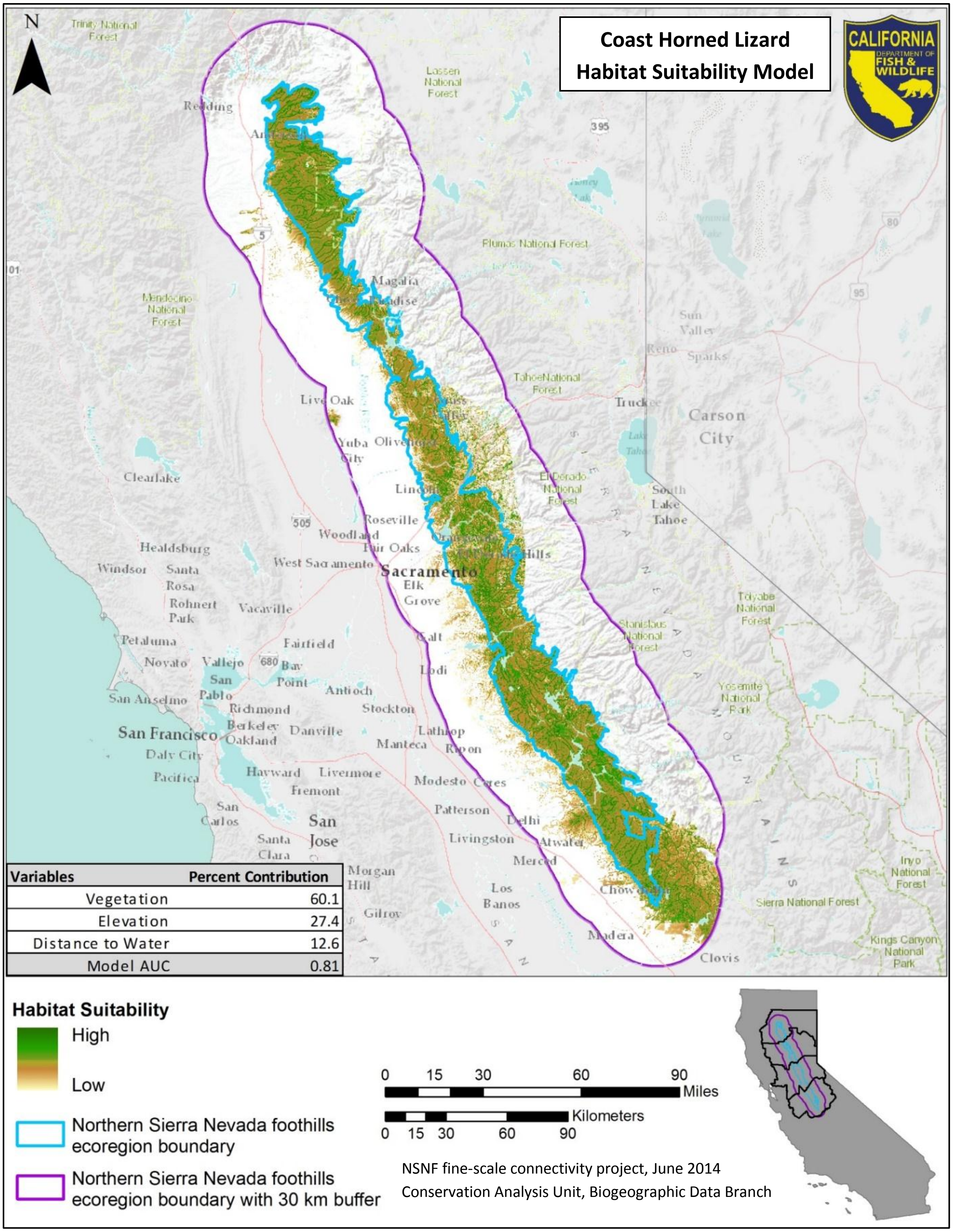


Figure S-43. Predicted habitat suitability for the Coast horned lizard (*Phrynosoma coronatum*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

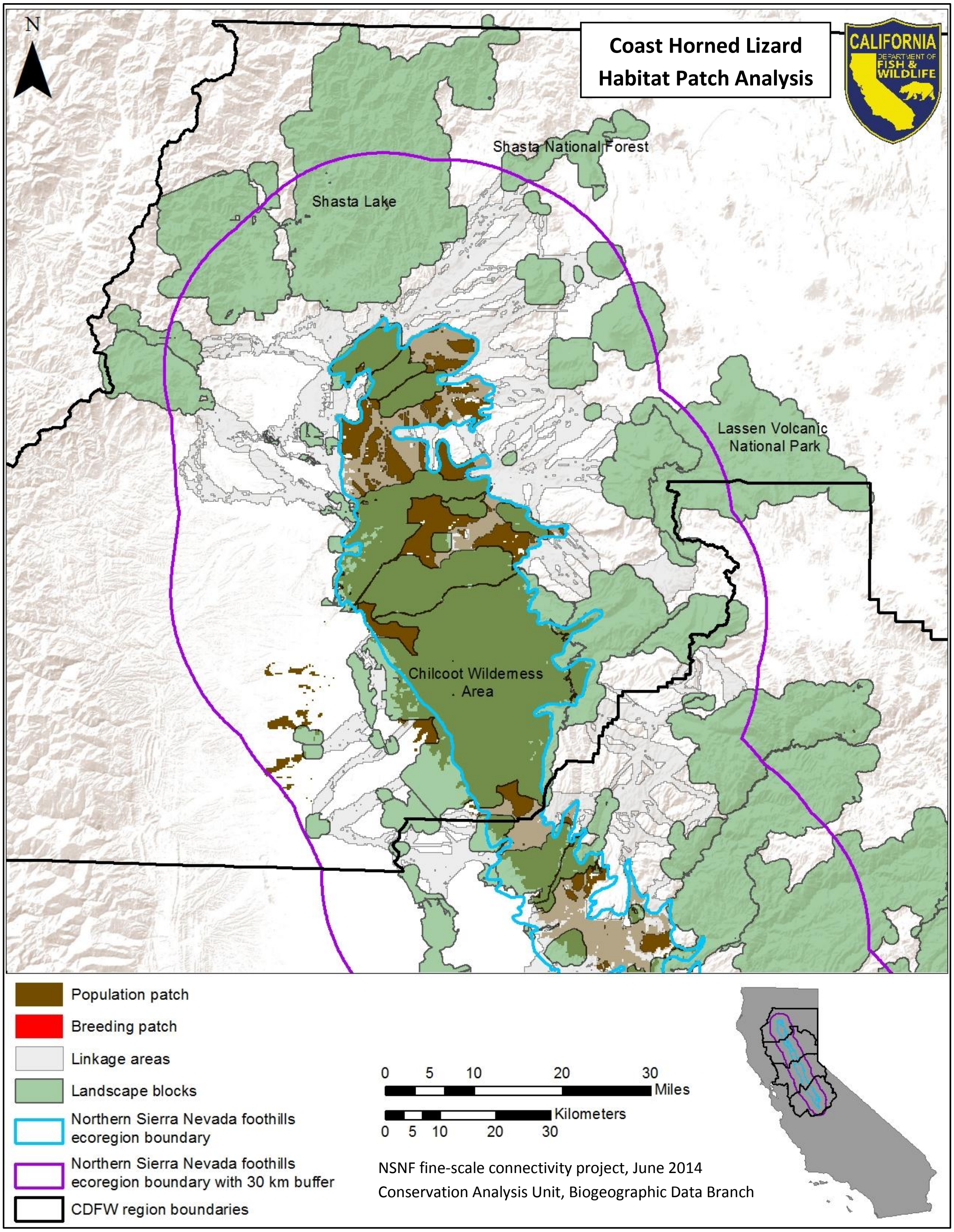


Figure S-44. Habitat patch analysis for the Coast horned lizard (*Phrynosoma coronatum*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >250 ha; breeding patches were contiguous areas of suitable habitat >20 ha.

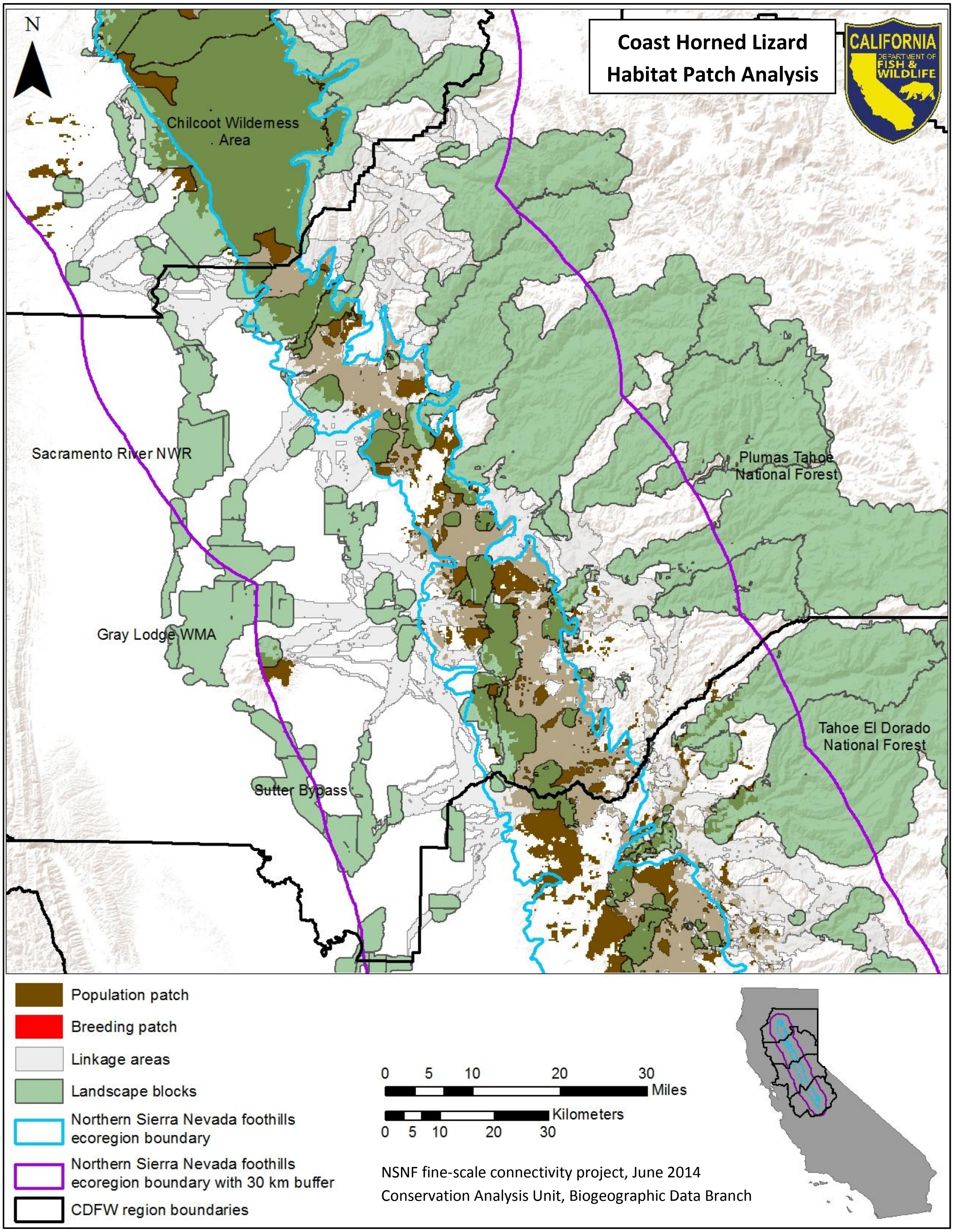


Figure S-45. Habitat patch analysis for the Coast horned lizard (*Phrynosoma coronatum*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >250 ha; breeding patches were contiguous areas of suitable habitat >20 ha.

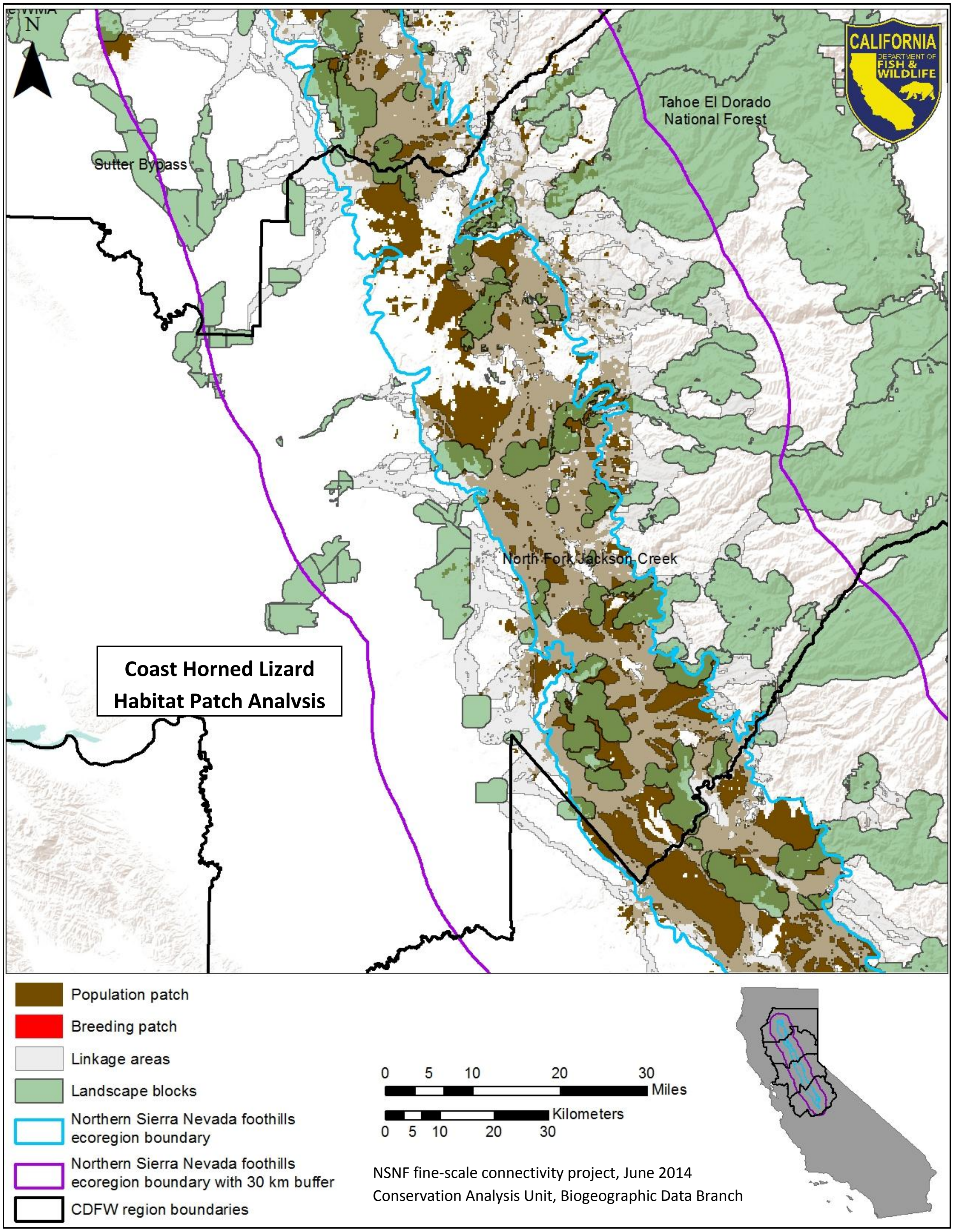


Figure S-46. Habitat patch analysis for the Coast horned lizard (*Phrynosoma coronatum*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >250 ha; breeding patches were contiguous areas of suitable habitat >20 ha.

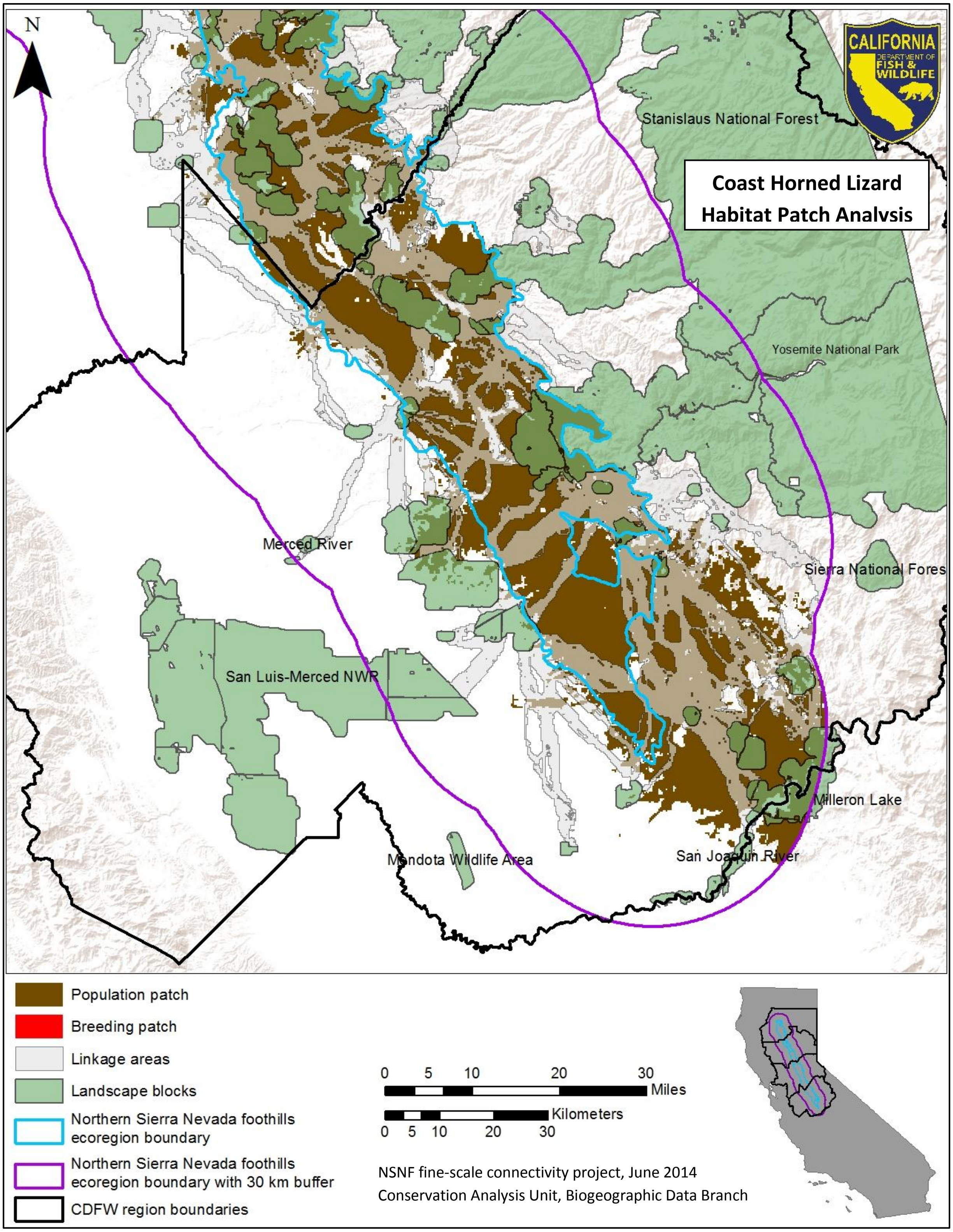


Figure S-47. Habitat patch analysis for the Coast horned lizard (*Phrynosoma coronatum*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >250 ha; breeding patches were contiguous areas of suitable habitat >20 ha.

Cooper's Hawk (*Accipiter cooperii*)

Focal species selection: Cooper's hawks are breeding residents throughout the foothills. Their habitat ranges from sea level to above 2700 m elevation, usually in dense stands of live oak, riparian deciduous or other forest habitats near water (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the Cooper's hawk was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for Cooper's hawk were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 2973 location points to train each model, 744 to test each model, and 9227 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range. In Michigan, Craighead and Craighead (1956) measured four home ranges that averaged 311 ha and varied from 96-401 ha. They estimated that 17 other home ranges averaged 207 ha and varied from 18-531 ha. They also reported one home range in Wyoming of 205 ha. Of 77 territories in California, in oak stands, mean distance between nests was 2.6 km (CWHR 2008). Minimum breeding patch size used was 50 ha; minimum population patch size was 500 ha (Curtis, Rosenfield et al. 2006).

Dispersal/Migration: The species may move downslope and south from areas of heavy snow in autumn and returns in spring (CWHR 2008). Maximum dispersal distance was 352 km (Curtis, Rosenfield et al. 2006).

Results and Discussion: The selected Cooper's hawk habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.73. The mean probability threshold was 0.34 predicting 3,325,902.1 ha of suitable habitat. The patch analysis identified 493 breeding patches covering 62,649.0 ha and 274 population patches covering 2,577,200.0 ha. Two hundred forty-four of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 83.5% of the total corridor area. Cooper's hawk habitat was categorized as low (threshold-50), medium (50-75) or high (75-

100) based on predicted suitability; 39% of habitat area in corridors had high predicted suitability, 53.6% medium and 7.50% low.

Potential habitat for the Cooper's hawk is scattered throughout the study area.

Region 1: Most habitat patches are continuous in the foothills and along the western portion of the northern region. The linkages capture most of the habitat patches.

Region 2 North: Habitat patches are scattered throughout this region of the study area and are captured by most linkages.

Region 2 South: Habitat patches are fairly continuous in the foothills and western side in this region of the study area. Habitat patches on the western side near the Consumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills are fairly continuous and are captured by most linkages. Habitat patches on the eastern side in this region of the study area are scattered but within dispersal distance for Cooper's hawk and are captured by a few linkages.

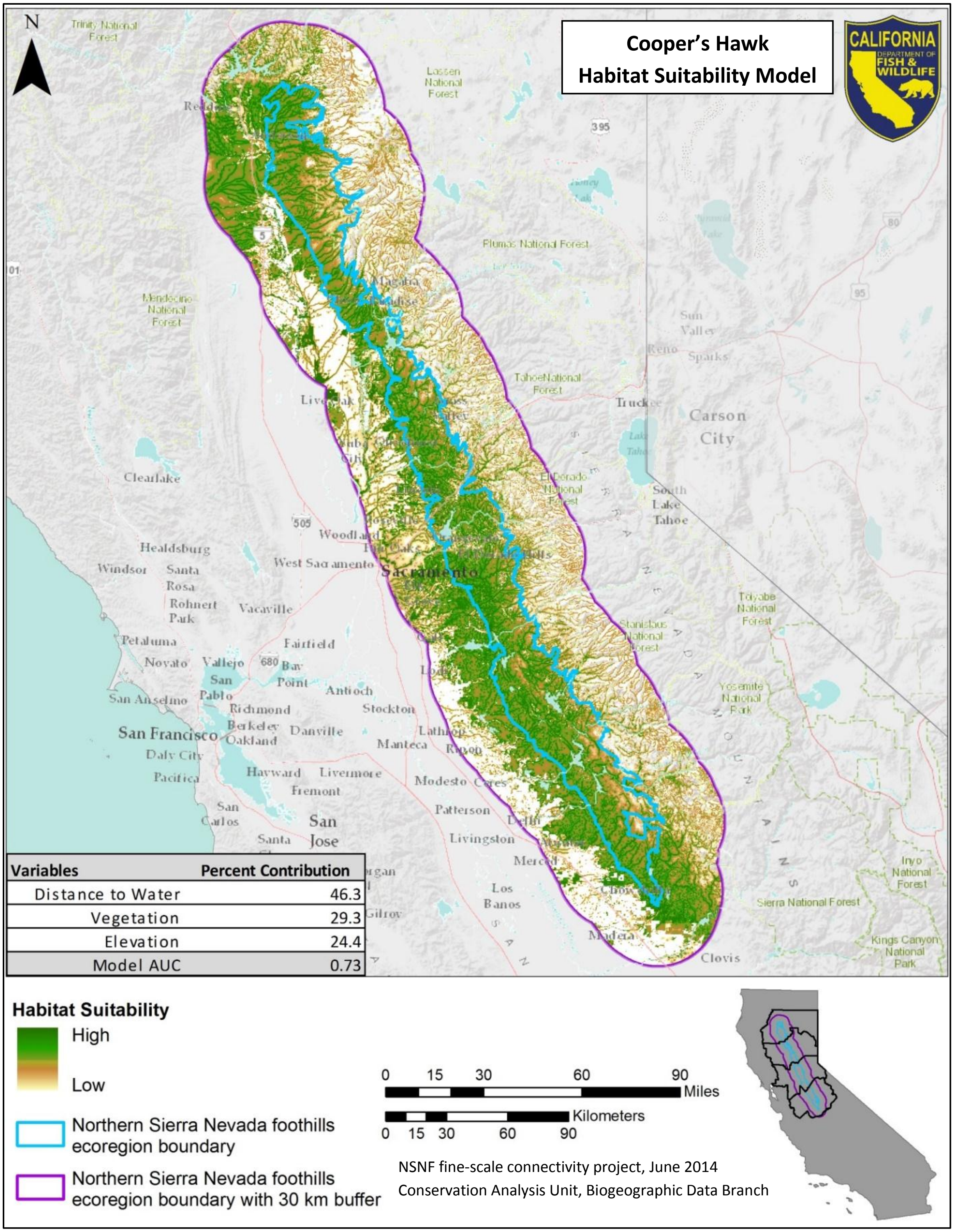
Region 4: Habitat patches in region of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.73	0.34	3,325,902.1	2,652,453.2	1,486

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
15.3	59.2	25.4

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
244	83.5	7.5	53.6	39

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
24.1	44.8	75.8	49.5



Variables	Percent Contribution
Distance to Water	46.3
Vegetation	29.3
Elevation	24.4
Model AUC	0.73

Figure S-48. Predicted habitat suitability for the Cooper's Hawk (*Accipiter cooperii*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

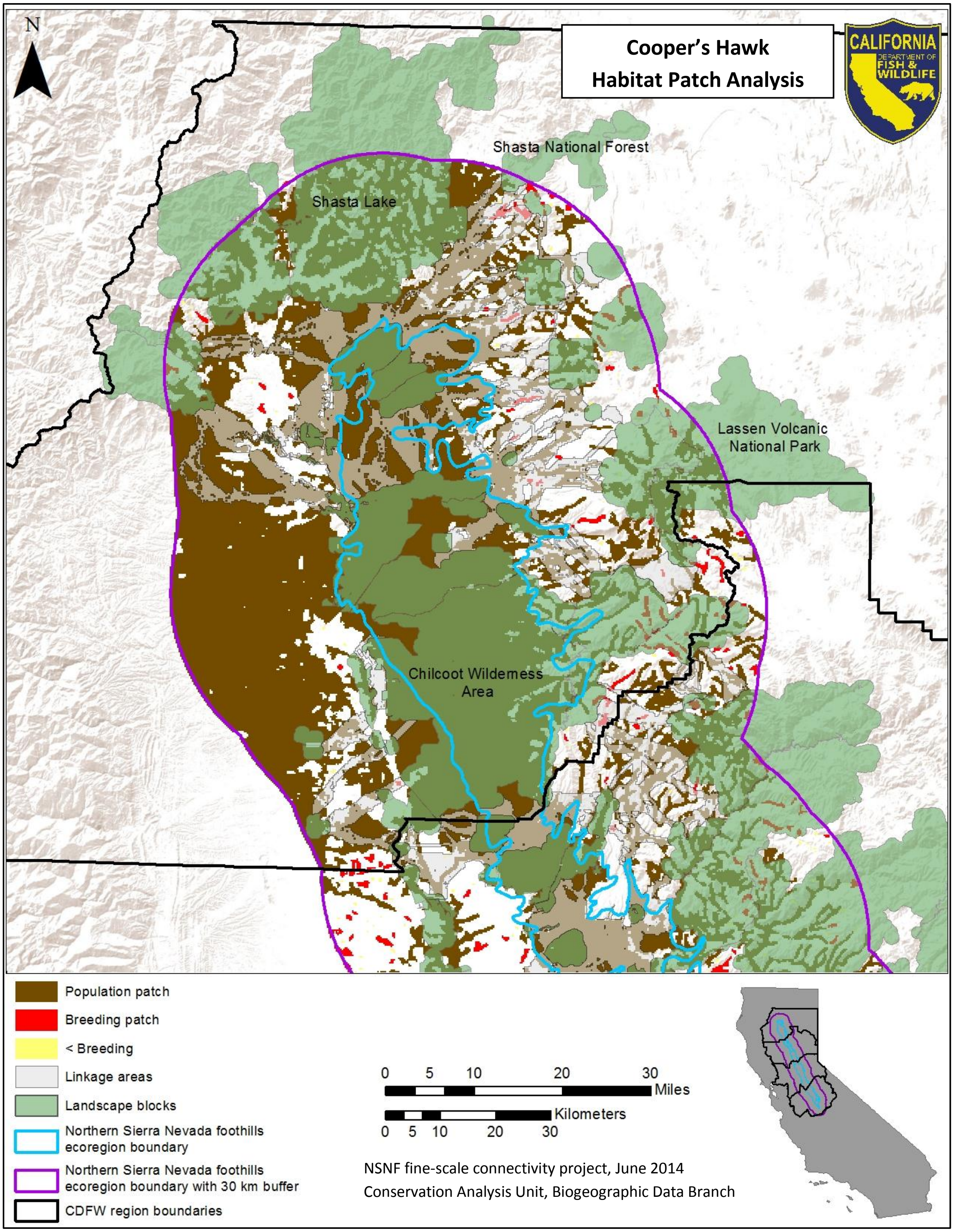


Figure S-49. Habitat patch analysis for the Cooper's Hawk (*Accipiter cooperii*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >50 ha.

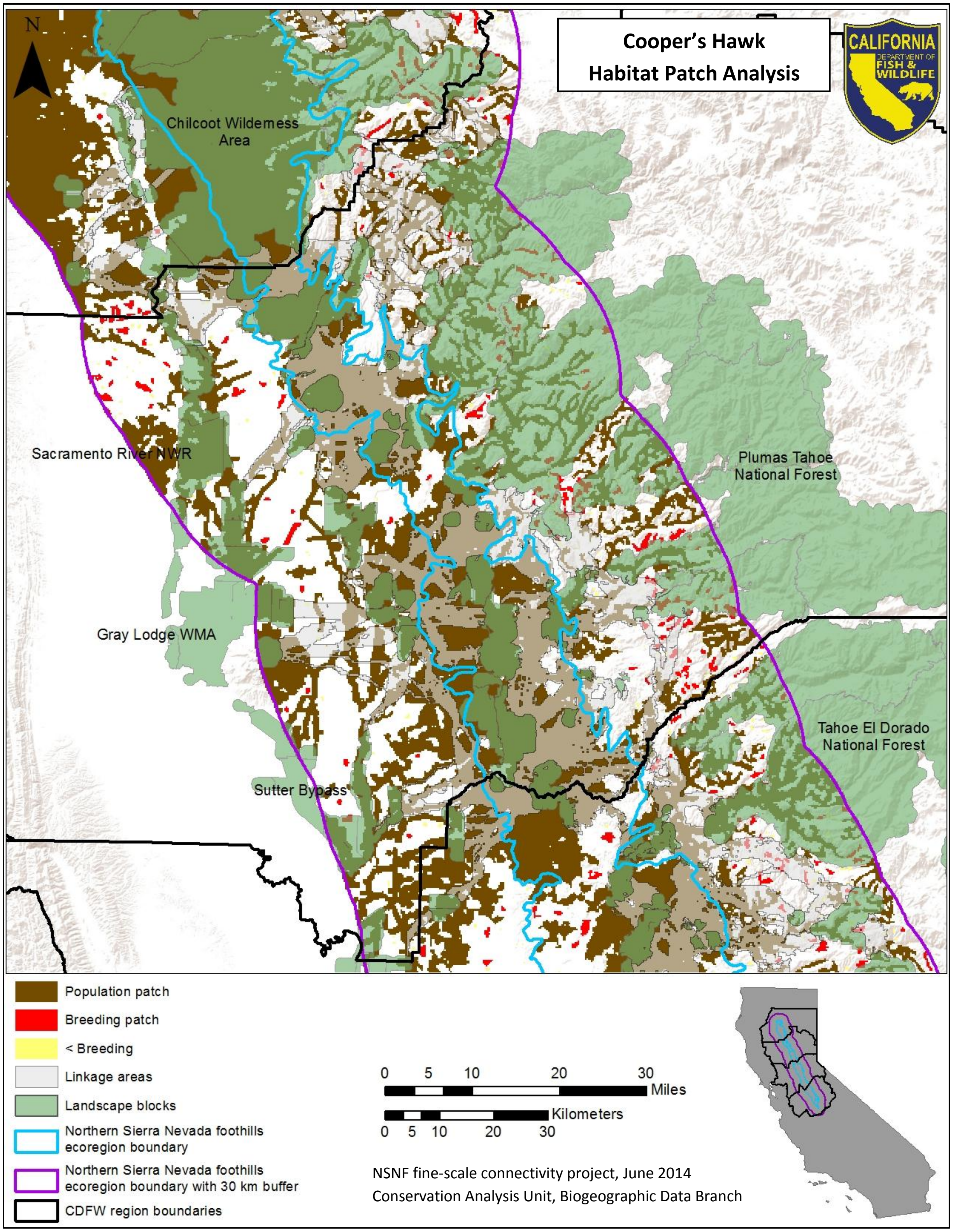


Figure S-50. Habitat patch analysis for the Cooper's Hawk (*Accipiter cooperii*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >50 ha.

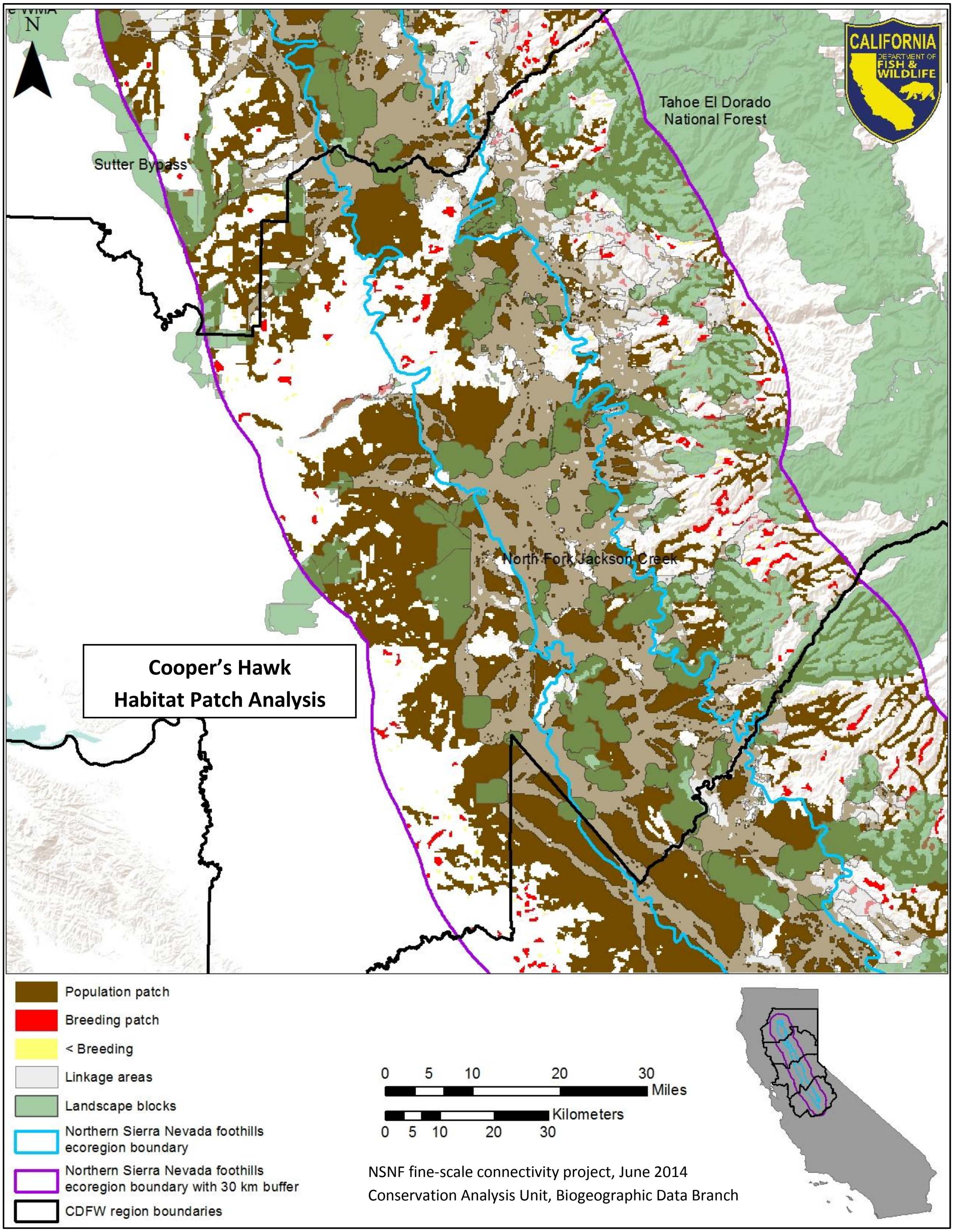


Figure S-51. Habitat patch analysis for the Cooper's Hawk (*Accipiter cooperii*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >50 ha.

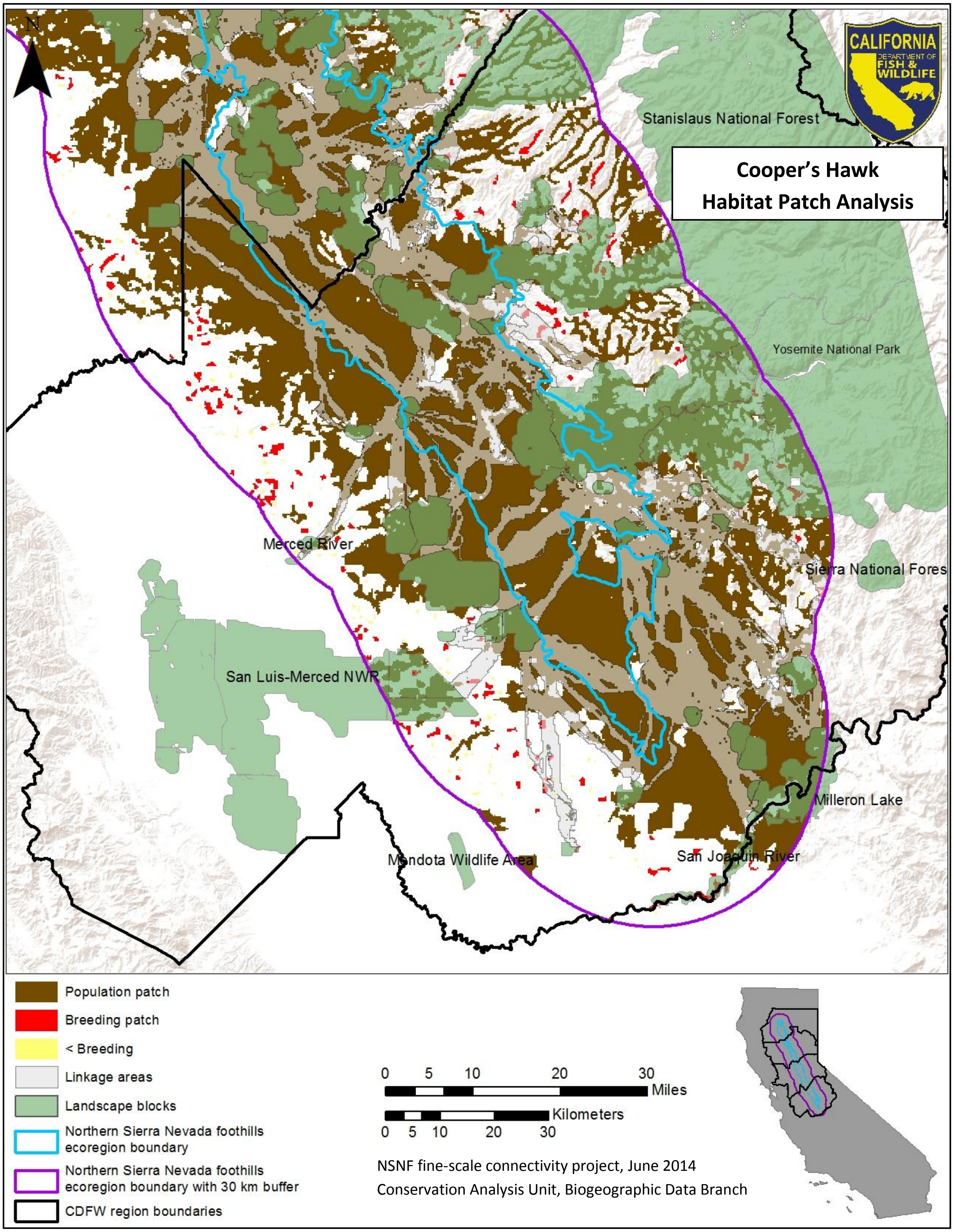


Figure S-52. Habitat patch analysis for the Cooper's Hawk (*Accipiter cooperii*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >50 ha.

Dusky-footed woodrat (*Neotoma fuscipes*)

Focal species selection: Dusky-footed woodrats are common in California, found mostly below 2150 m elevation (CWHR 2008). The species prefers forest habitats with moderate, year-round greenery, and a brushy understory. Its houses are built of sticks and leaves at the base of or in trees, around shrubs or at the base of hills (CWHR 2008). It drinks water, but may be sustained by leafy vegetation and fungi (CWHR 2008). The dusky-footed woodrat is **barrier sensitive** and **disturbance sensitive**. Disturbances that destroy houses including human activity, cattle grazing, and fire, are detrimental to woodrats.

Habitat Model: The final three habitat suitability models developed for Dusky-footed woodrat were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 441 location points to train each model, 111 to test each model, and 9862 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range. In Sonoma County home ranges averaged 0.23 ha for males, 0.19 ha for females, and 0.17 for juveniles; densities reached a peak of 20 individuals/ha in late summer (Cranford 1977). In Monterey County, an individual was found to confine its lifetime activity around a single tree, or range over 18.7 ha (Lindsdale and Tevis 1951). In chaparral habitat, density was reported to 18.8/ha (Bleich 1973). Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: Non-migratory. Maximum dispersal distance used was 434 m (Penrod, Cabanero et al. 2004).

Results and Discussion: The selected dusky-footed woodrat habitat suitability model was Maxent scenario 9. The model performed well with an AUC of 0.88. The mean probability threshold was 0.21, predicting 4,032,886.3 ha of suitable habitat. The patch analysis identified 1545 population patches covering 2,153,520.3 ha. We identified 97 dusky-footed woodrat least-cost corridors. Habitat patches covered 82.6% of the total corridor area. The majority of corridors were on the eastern side of the study area and ranged in elevation from 25 m to 2031 m. The least-cost corridors covered 547,666.9 ha of land, of those 14% were designated as GAP 1, 2 or 3 lands or in conservation easements, 86% were private lands. Dusky-footed woodrat corridors covered many different vegetation types, 32% of the total corridor area was in oak woodland, 20%in grassland, 14% in hardwood and 11% in mixed conifer. Dusky-footed woodrat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 0.2% of habitat area in corridors had high predicted suitability, 11% medium and 88.8% low.

Potential habitat for the dusky-footed woodrat is widespread throughout the foothills and eastern side of the study area.

Region 1: Habitat is fairly continuous on the eastern side in this region of the study area. In the foothills and western side habitat is scattered. Habitat patches on the western side are isolated from the main foothill blocks. Fifteen of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat is limited to the foothills and eastern side in this region of the study area. Habitat patches are fairly continuous. Twenty-nine of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat is fairly continuous in this region. Forty-one of the corridors are in this region of the study area and capture most of the habitat patches.

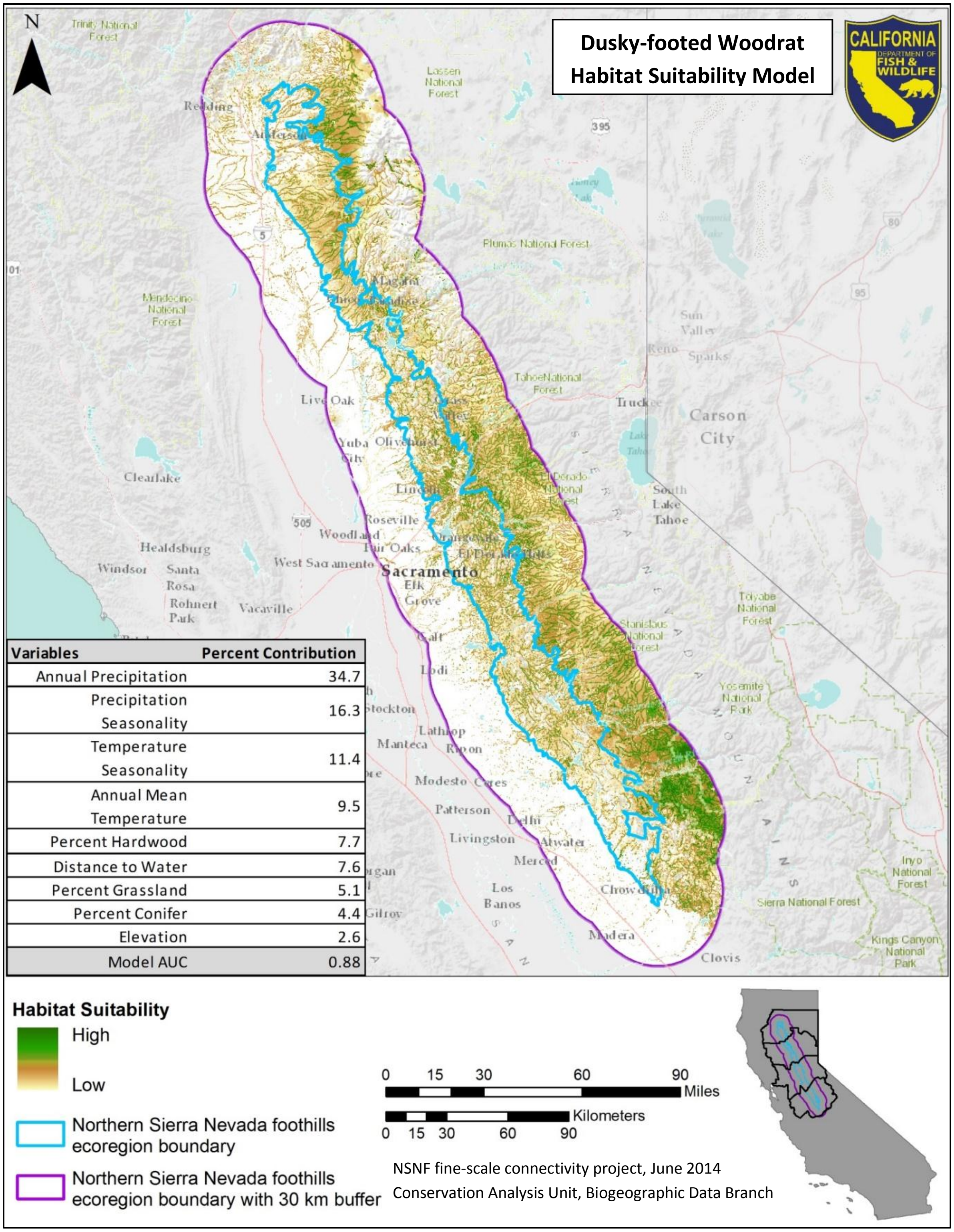
Region 4: Habitat is limited to foothills and eastern side in this region of the study area. Habitat patches are scattered in the foothills and fairly continuous on the eastern side of the region. A few scattered patches on the western side are isolated from the main foothill blocks. Twenty-four of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.88	0.21	4,032,886.3	2,153,520.3	1,545

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
50.1	6.5	0.2

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
97	82.6	88.8	11.0	0.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
23.3	22.2	12.2	23.1



Variables	Percent Contribution
Annual Precipitation	34.7
Precipitation Seasonality	16.3
Temperature Seasonality	11.4
Annual Mean Temperature	9.5
Percent Hardwood	7.7
Distance to Water	7.6
Percent Grassland	5.1
Percent Conifer	4.4
Elevation	2.6
Model AUC	0.88

Figure S-53. Predicted habitat suitability for the dusky-footed woodrat (*Neotoma fuscipes*). Environmental variables for the Maxent scenario 9 included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water and vegetation represented by four continuous variables

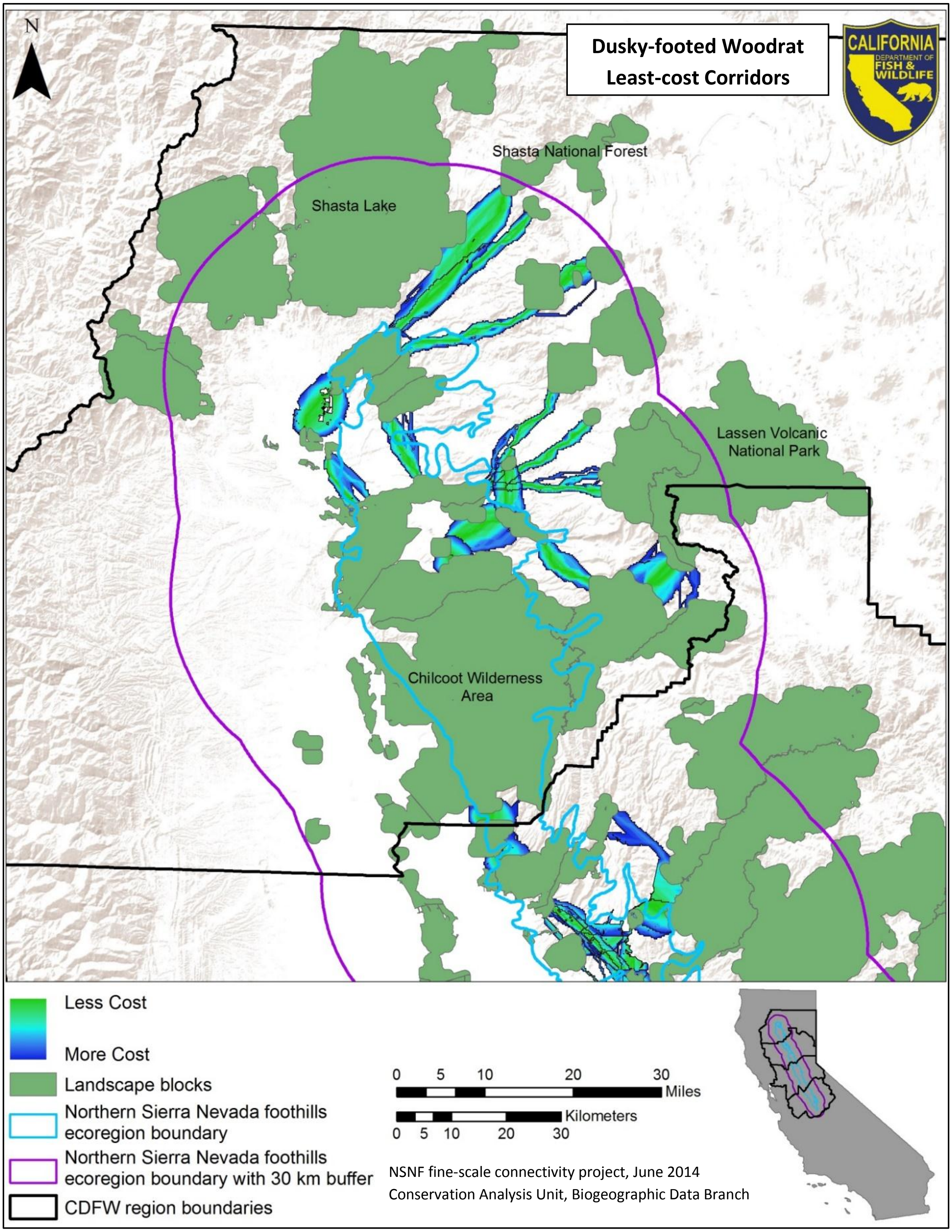


Figure S-54. Least-cost corridor analysis for the dusky-footed woodrat (*Neotoma fuscipes*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

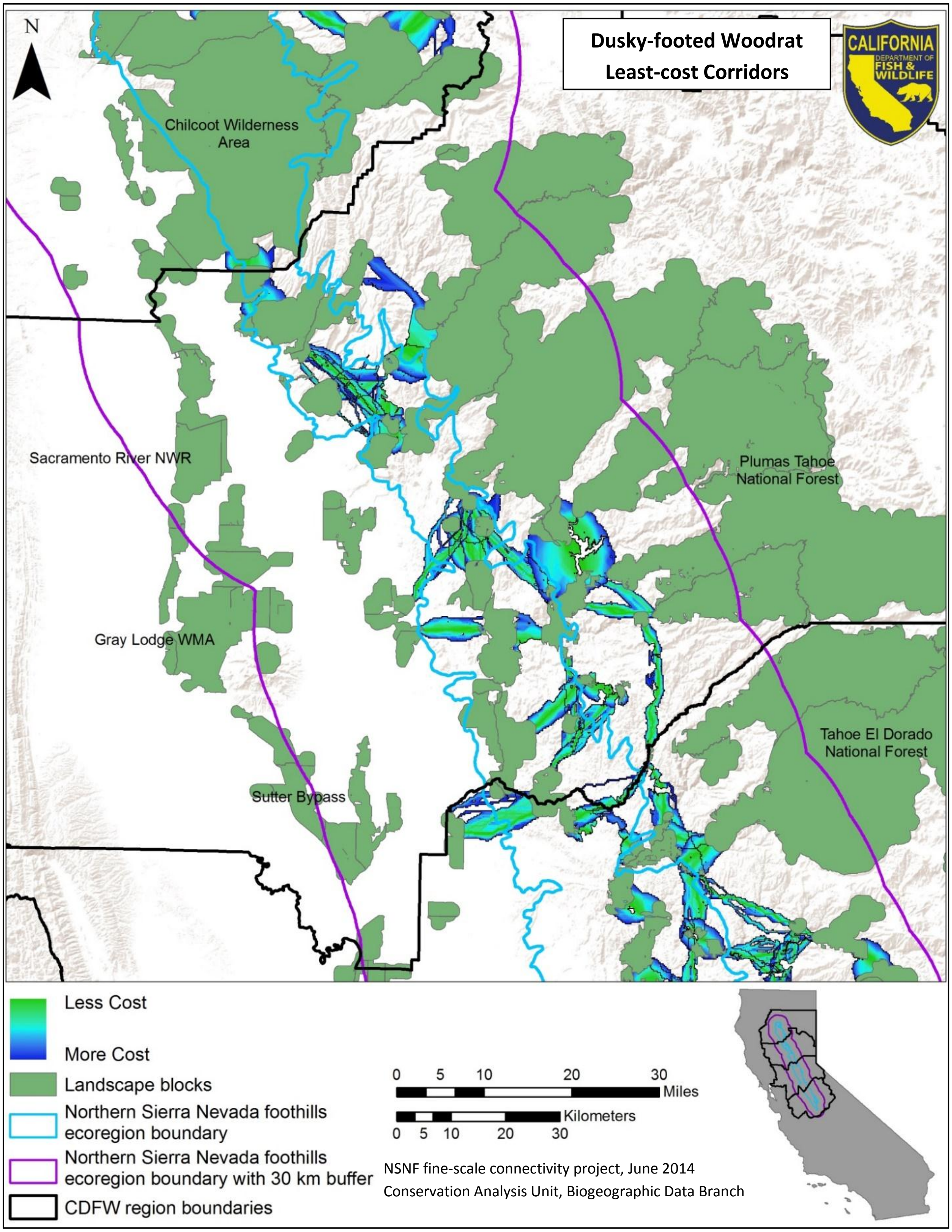


Figure S-55. Least-cost corridor analysis for the dusky-footed woodrat (*Neotoma fuscipes*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

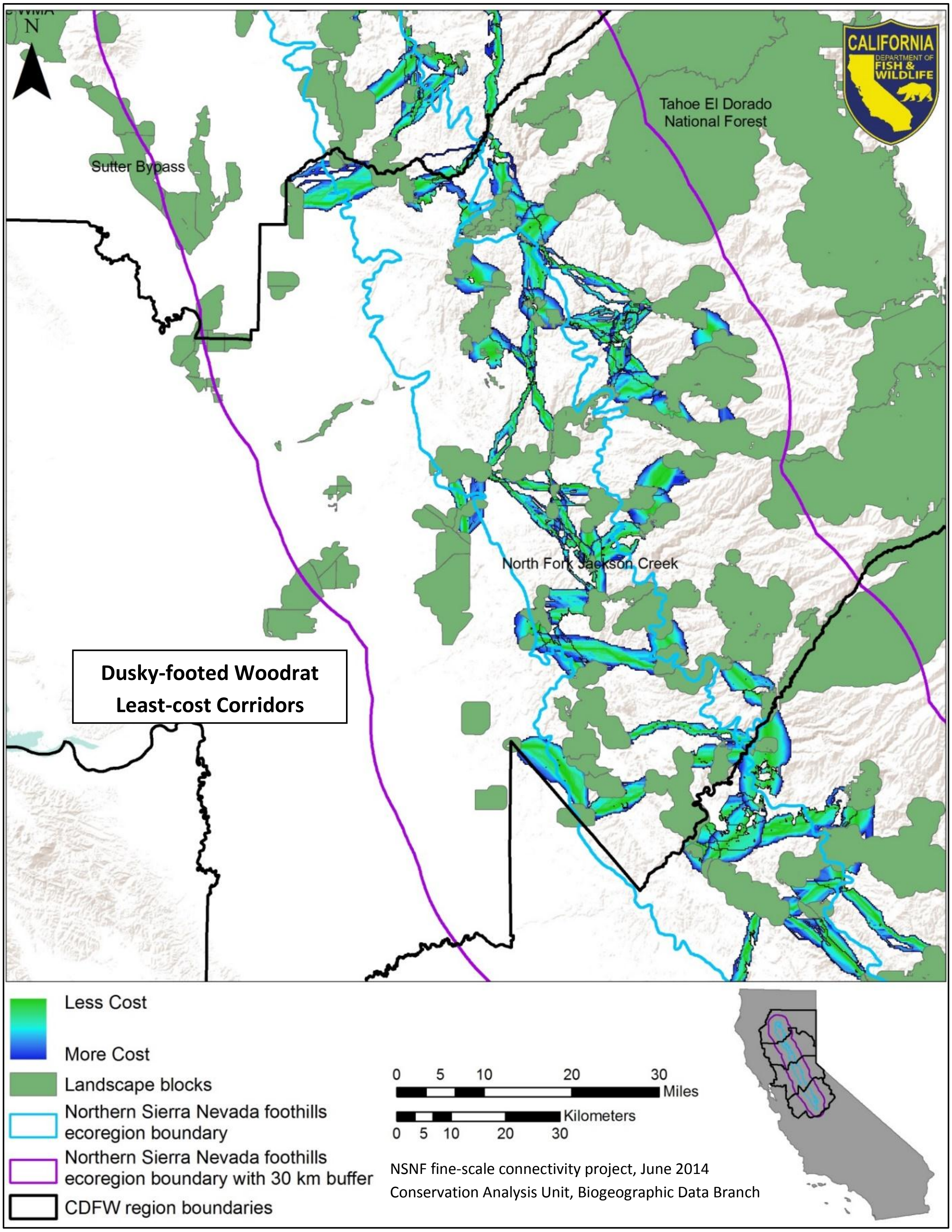


Figure S-56. Least-cost corridor analysis for the dusky-footed woodrat (*Neotoma fuscipes*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

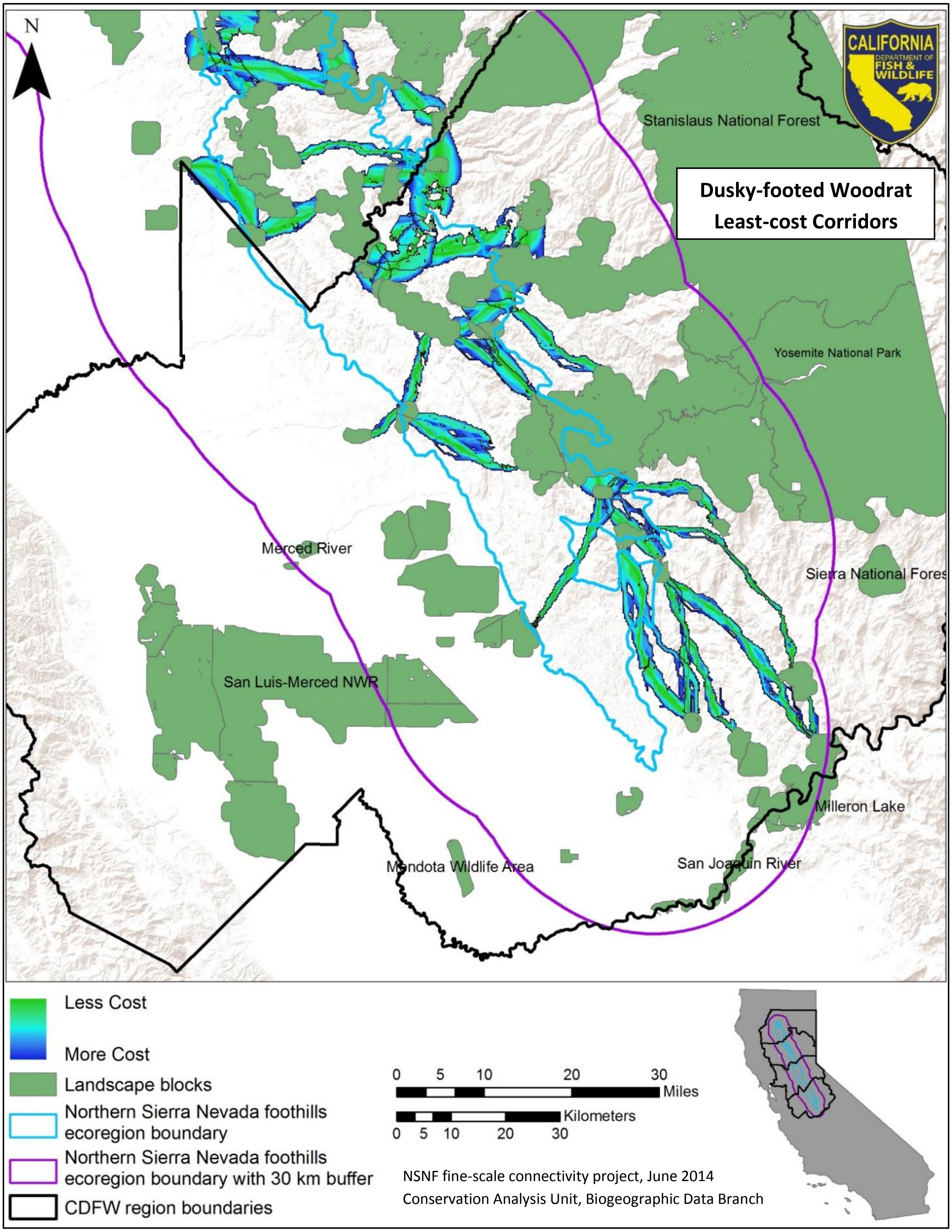


Figure S-57. Least-cost corridor analysis for the dusky-footed woodrat (*Neotoma fuscipes*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Foothill yellow-legged frog (*Rana boylii*)

Focal species selection: Foothill yellow-legged frogs are found along the western flanks of the Sierra south to Kern County. They are found in or near rocky streams in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral and wet meadow types (CWHR 2008). Unlike most other ranid frogs of Calfornia, this species is rarely encountered far from permanent water; tadpoles require water for at least three to four months (CWHR 2008). The foothill yellow-legged frog is a **corridor dweller** species of riparian habitats.

Habitat Model: The final three habitat suitability models developed for Foothill yellow-legged frog were the expert opinion CWHR Bioview, and Maxent scenarios 7w and 9w. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 1350 location points to train each model, 338 to test each model, and 9635 background points. Environmental variables for the Maxent scenario 7w model included elevation, distance to water and vegetation represented by five continuous variables (percent wetland, percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9w model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water and vegetation represented by five continuous variables.

Patch Analysis: Territory/Home Range. Normal home ranges are probably less than 10 m in the longest dimension (CWHR 2008). Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: Occasional long distance movements up to 50 m may occur during periods with high water conditions (CWHR 2008). Maximum dispersal distance of 50 m was used.

Results: The selected Foothill yellow-legged frog habitat suitability model was the Maxent scenario 7w. The model performed well with an AUC of 0.95. The mean probability threshold was 0.16 predicting 2,084,386.05 ha of suitable habitat. The patch analysis identified 1309 population patches covering 704,260.8 ha. Thirty of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 45.2% of the total corridor area. Foothill yellow-legged frog habitat was categorized as low (threshold-

50), medium (50-75) or high (75-100) based on predicted suitability; 24.4% of habitat area in the corridors had high predicted suitability, 16.3% medium and 59.4% low.

Potential habitat for foothill yellow-legged frog is limited to riparian areas and scattered throughout the study area.

Region 1: Connectivity is limited in this region of the study area and is limited to Shasta Lake block and Cow Creek block, Chilcoot WA and Battle Creek block. Most of the habitat patches are captured in landscape blocks.

Region 2 North: Habitat patches are scattered in this region of the study area. Habitat patches on the western side are isolated from the main foothill area. Connectivity is limited to connections between the following pairs of blocks: Chico block and Plumas-Tahoe NF block, Jordan Hill block and Plumas-Tahoe NF block, Lake Earl Wildlife Area block and Spenceville WMA block, Yuba River block and Plumas-Tahoe NF block, Spenceville WMA block and Yuba River block, and Spenceville WMA block and Big Hill-Bear River block.

Region 2 South: Connectivity is limited to three sections in this region of the study area. In the northern section of this region, connections were found between the Tahoe-El Dorado NF block, Middle American River blocks, Morman Hill-South Fork American River block and the South Fork American River block. In the center section, the Yosemite-Stanislaus NF block was connected with the North Cosumnes River block and Crevis Creek block; and the South Fork Dry Creek block with the Yosemite-Stanislaus NF block. In the southern region, Bear Mountains-Gopher Ridge block is connected with the Lincoln block, Snow Creek block, Calaveras Big Trees block and the New Melones block.

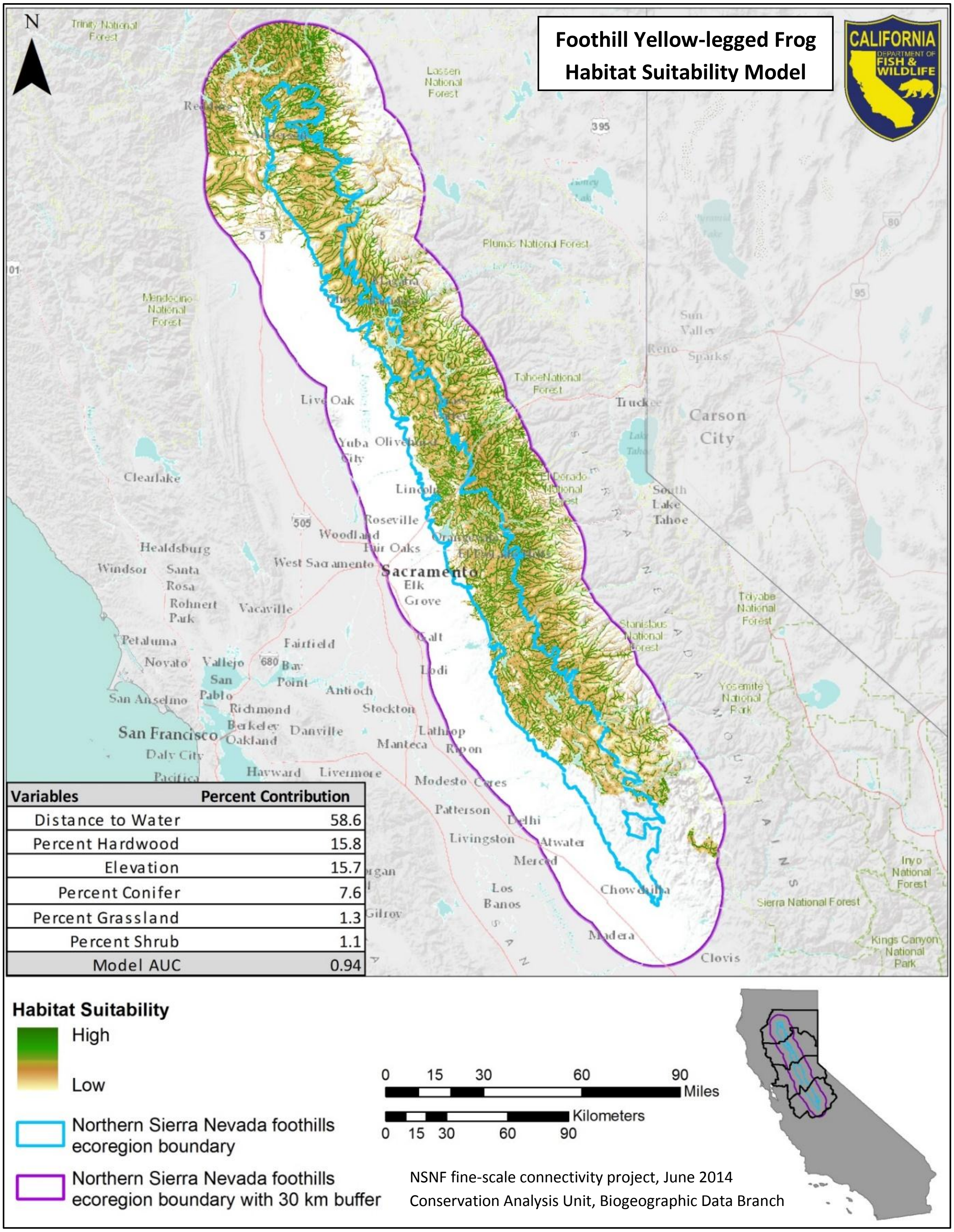
Region 4: Habitat is limited in this region with only scattered patches in the study area. Connectivity is limited to the Lincoln block and La Grange block, between Stanislaus NF block and Yosemite-Stanislaus NF block, and between Yosemite-Stanislaus NF block and Airway Beacon block.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.95	0.16	2084386.0	704360.8	1309

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
68.1	15.1	16.8

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
30	45.2	59.4	16.3	24.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
6.9	8.5	11.4	7.9



Variables	Percent Contribution
Distance to Water	58.6
Percent Hardwood	15.8
Elevation	15.7
Percent Conifer	7.6
Percent Grassland	1.3
Percent Shrub	1.1
Model AUC	0.94

Figure S-58. Predicted habitat suitability for the foothill yellow-legged frog (*Rana boylii*). Environmental variables for the Maxent scenario 7w model included elevation, distance to water, and vegetation represented by five continuous variables (percent wetland, percent conifer, percent grassland, percent hardwood and percent shrub).

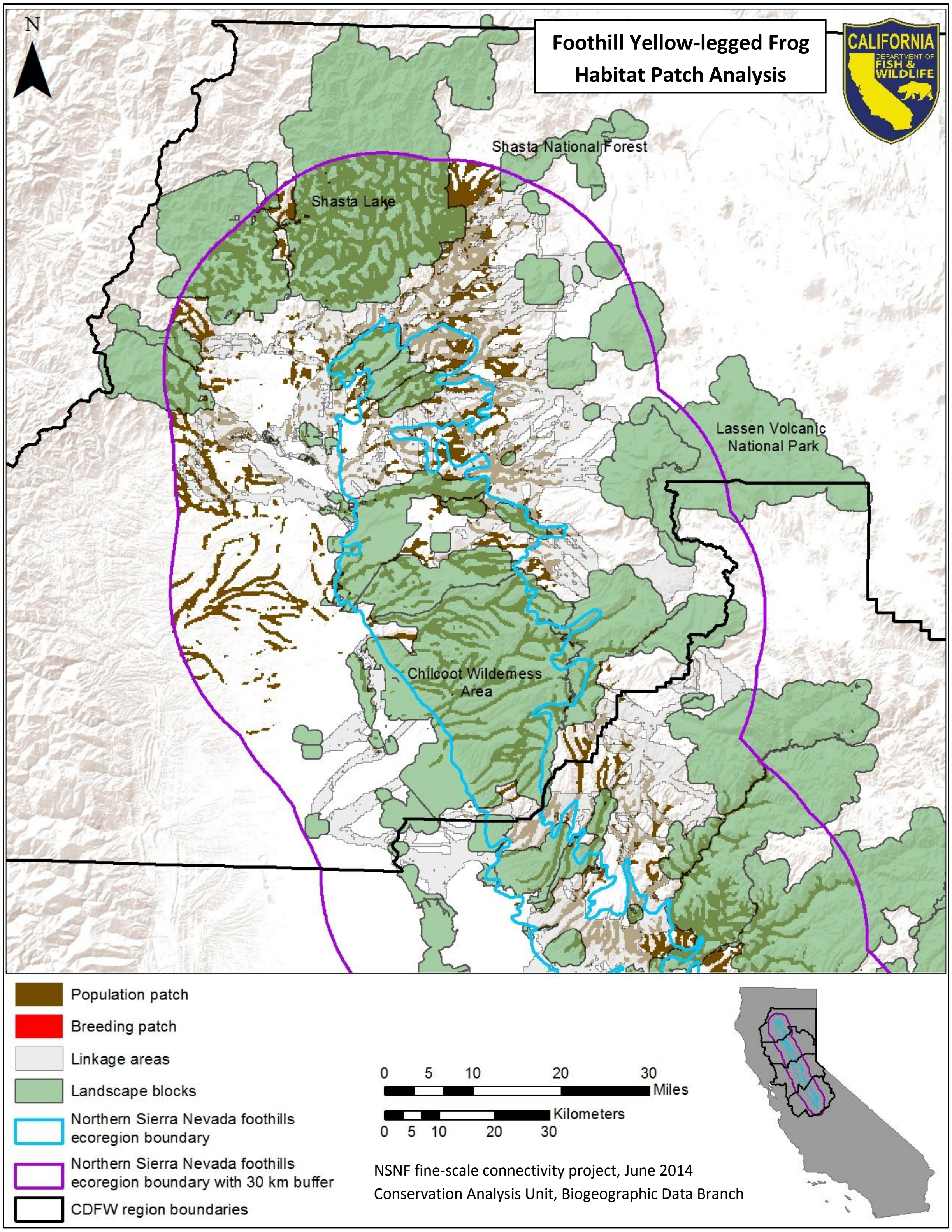


Figure S-59. Habitat patch analysis for the foothill yellow-legged frog (*Rana boylii*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

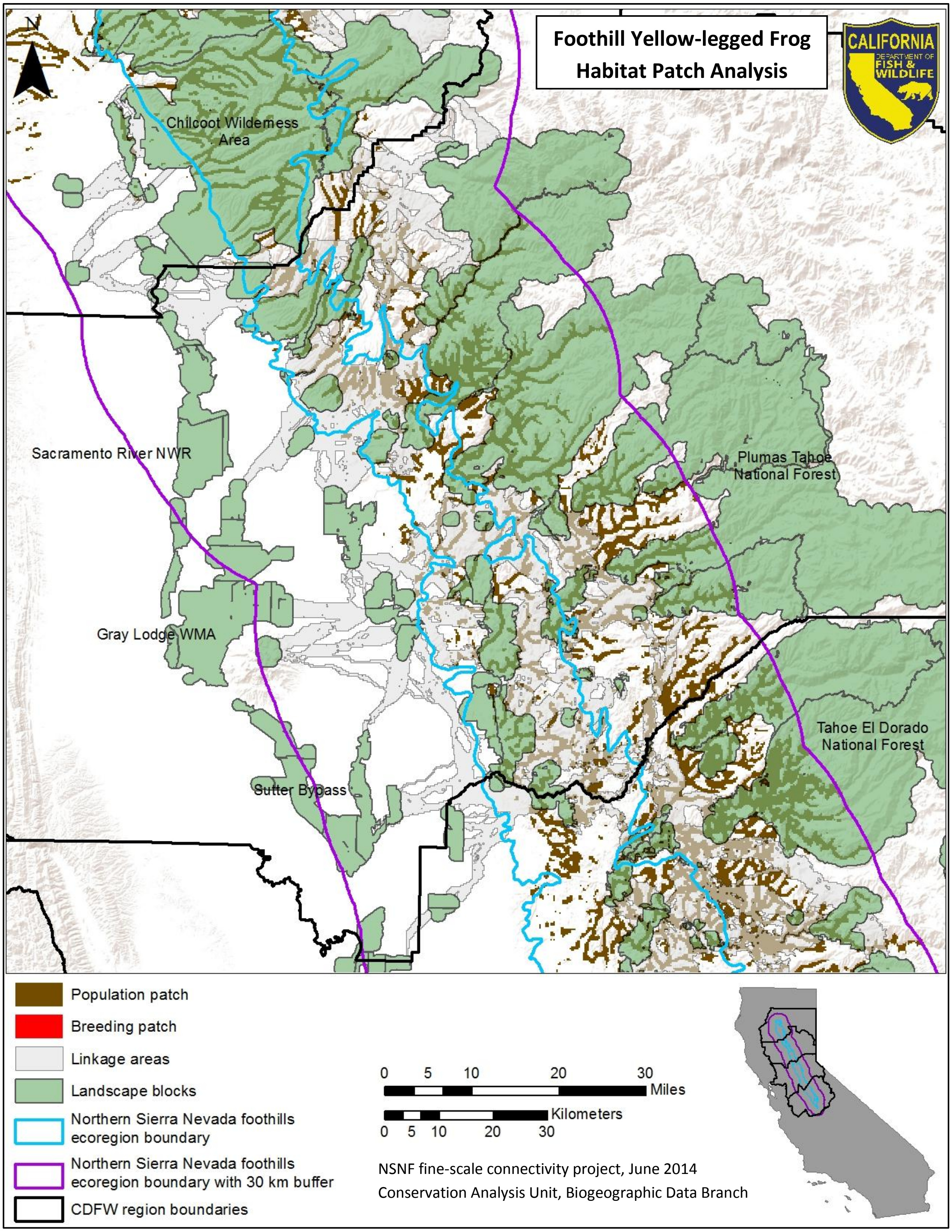


Figure S-60. Habitat patch analysis for the foothill yellow-legged frog (*Rana boylii*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

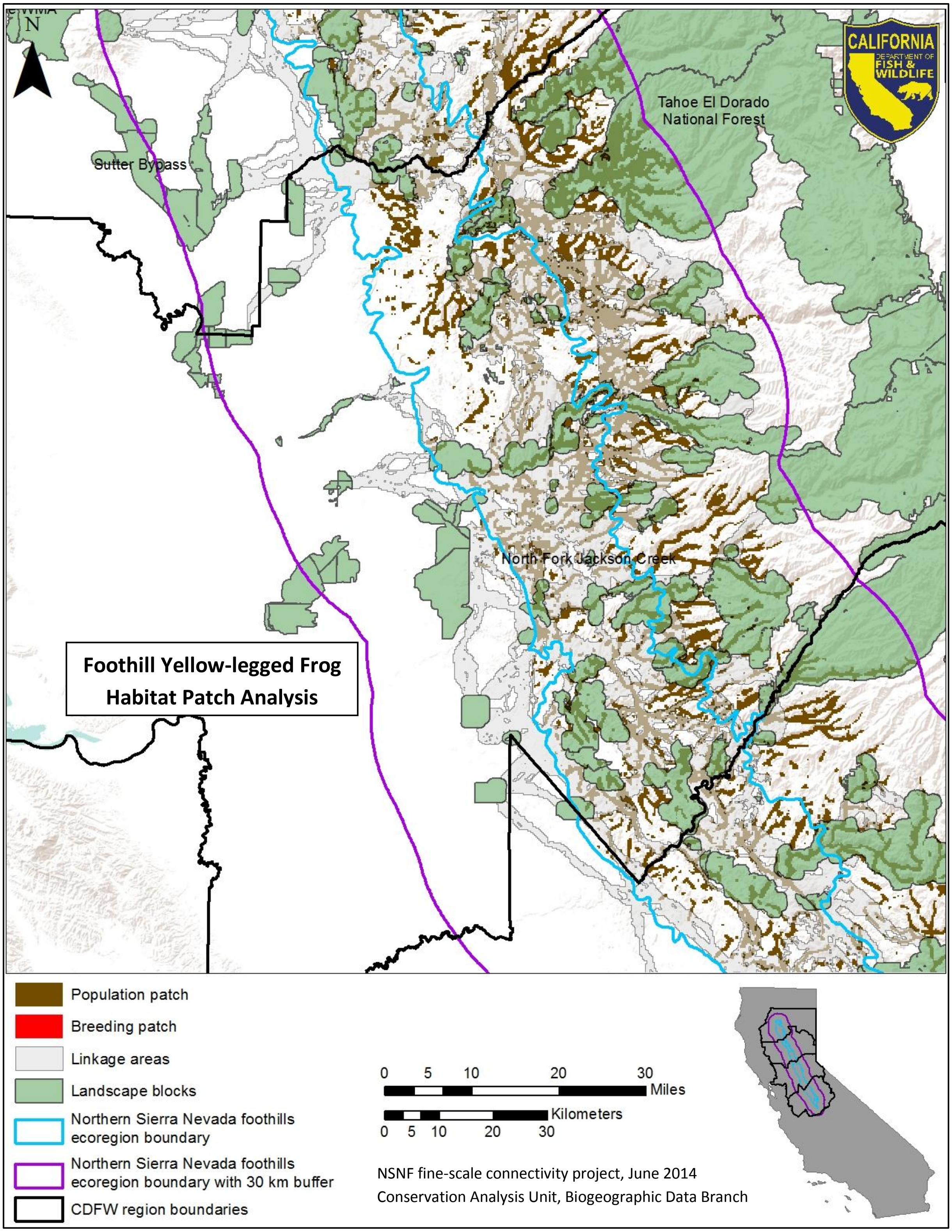


Figure S-61. Habitat patch analysis for the foothill yellow-legged frog (*Rana boylii*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

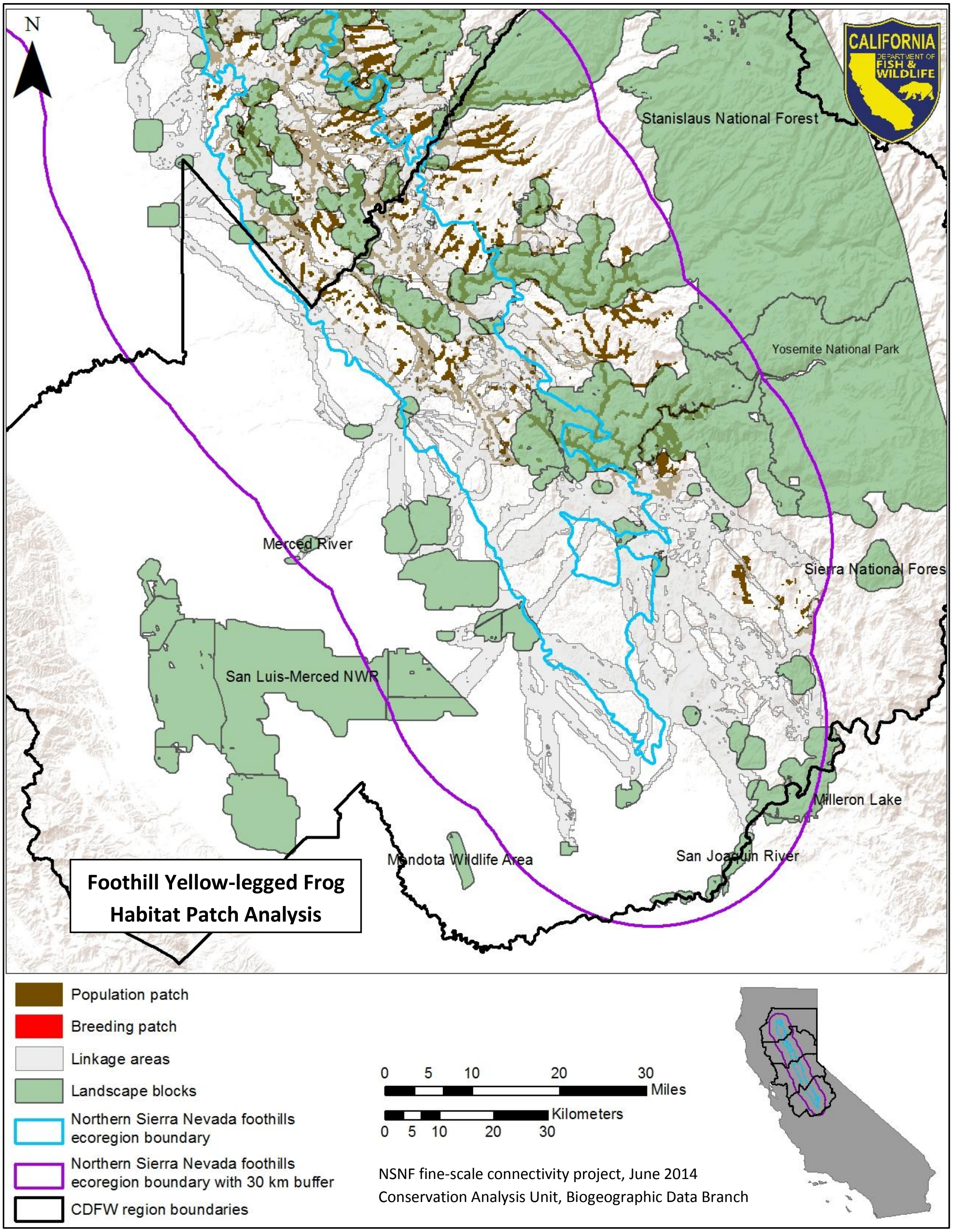


Figure S-62. Habitat patch analysis for the foothill yellow-legged frog (*Rana boylii*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

Gopher snake (*Pituophis catenifer*)

Focal species selection: Gopher snakes are common throughout the foothills and are found in all habitats. Preferred habitat is sparse and open grassy stages, and the species is generally absent only from densely forested habitat stages in the Sierra Nevada (CWHR 2008). The gopher snake's elevation range extends up to 2740 m (Stebbins 1985). No information on water requirements was found; standing water is not an important habitat element (CWHR 2008). The gopher snake was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for gopher snake were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 1304 location points to train each model, 327 to test each model, and 9656 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range. The nature of the home range of California gopher snakes is not well knows. Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha (Rodriquez-Robles 2003).

Dispersal/Migration: In Utah, gopher snakes make annual movements to and from hibernacula (Parker and Brown 1973); it is probable that this also occurs in California. Maximum dispersal distance of 150 m (Rodriquez-Robles 2003) was used.

Results and Discussion: The selected gopher snake habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.61. The model predicted 4,122,407.5 ha of suitable habitat. The patch analysis identified 388 breeding patches covering 3,768.8 ha and 788 population patches covering 3,193,944.4 ha. One hundred ninety-five of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 94.1% of the total corridor area. Gopher snake habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 61.2% of habitat area in the corridors had high predicted suitability, 20.1% medium and 18.7% low.

Potential habitat for gopher snake is widespread throughout the study area.

Region 1: Most habitat patches are continuous throughout the northern region and are captured by most linkages.

Region 2 North: Habitat is fairly continuous and captured by most linkages in the foothills and western side in this region of the study area.

Region 2 South: Habitat patches in the foothills and western side of the study area are fairly continuous and are captured by most linkages. Habitat patches on the eastern side are scattered and isolated. The Silver Creek-Lower American River and Dark Canyon blocks are isolated from the main foothill blocks.

Region 4: Habitat patches are fairly continuous and are captured by most linkages.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.61	n/a	4122407.5	3197713.2	1176

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
42.4	22.4	35.2

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
195	94.1	18.7	20.1	61.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
15.3	31.2	60.4	34.7

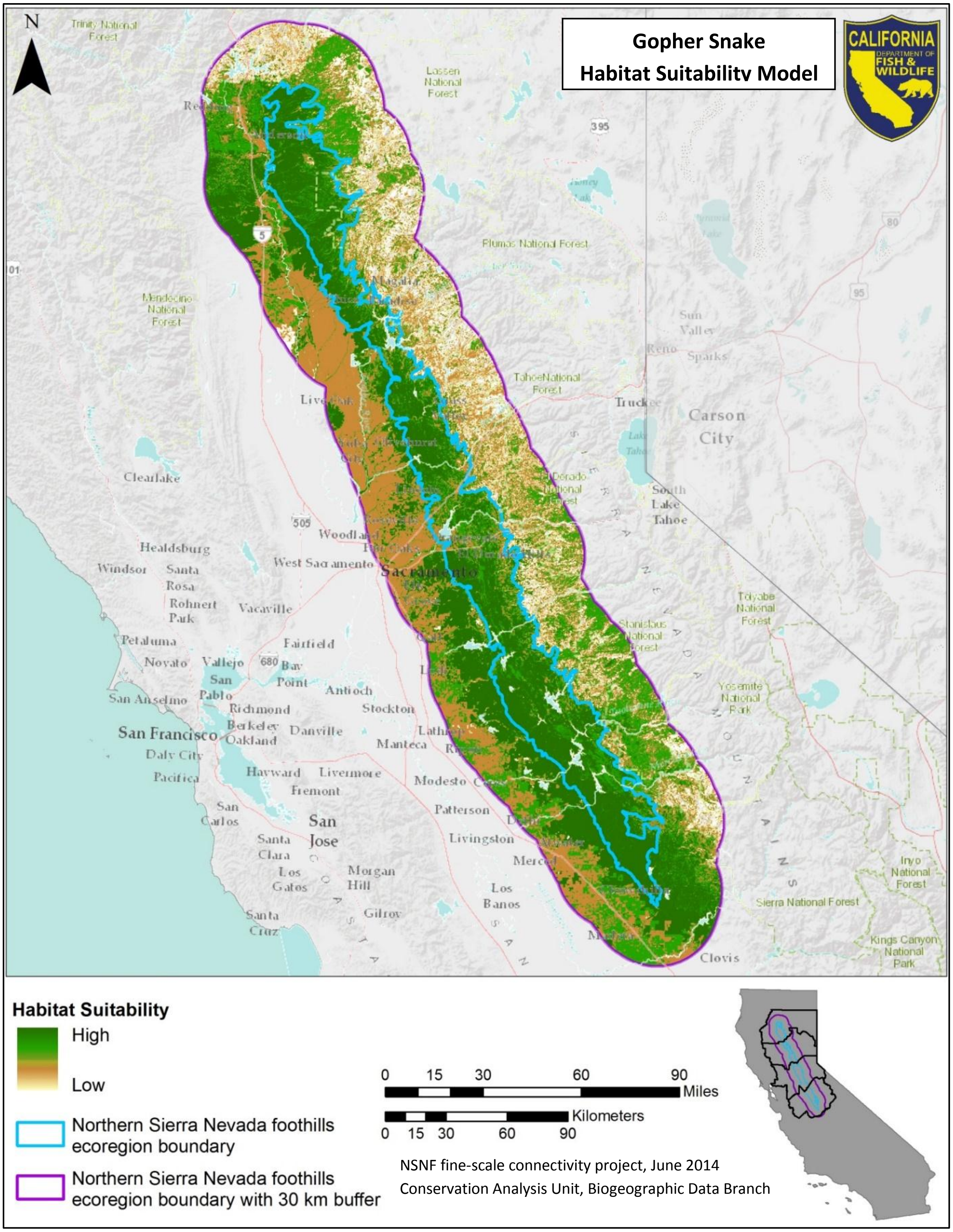


Figure S-63. Predicted habitat suitability for the gopher snake (*Pituophis catenifer*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes**.**

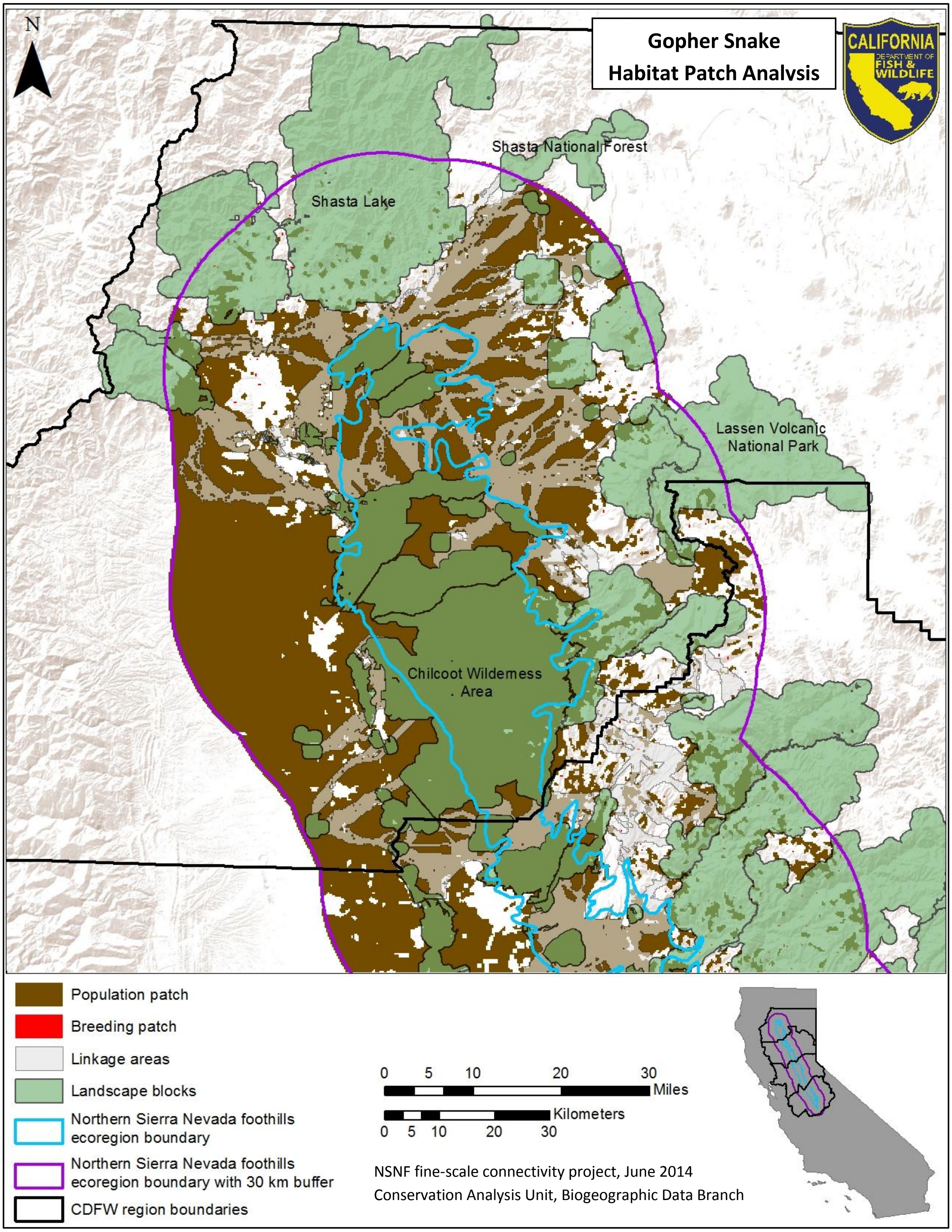


Figure S-64. Habitat patch analysis for the gopher snake (*Pituophis catenifer*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

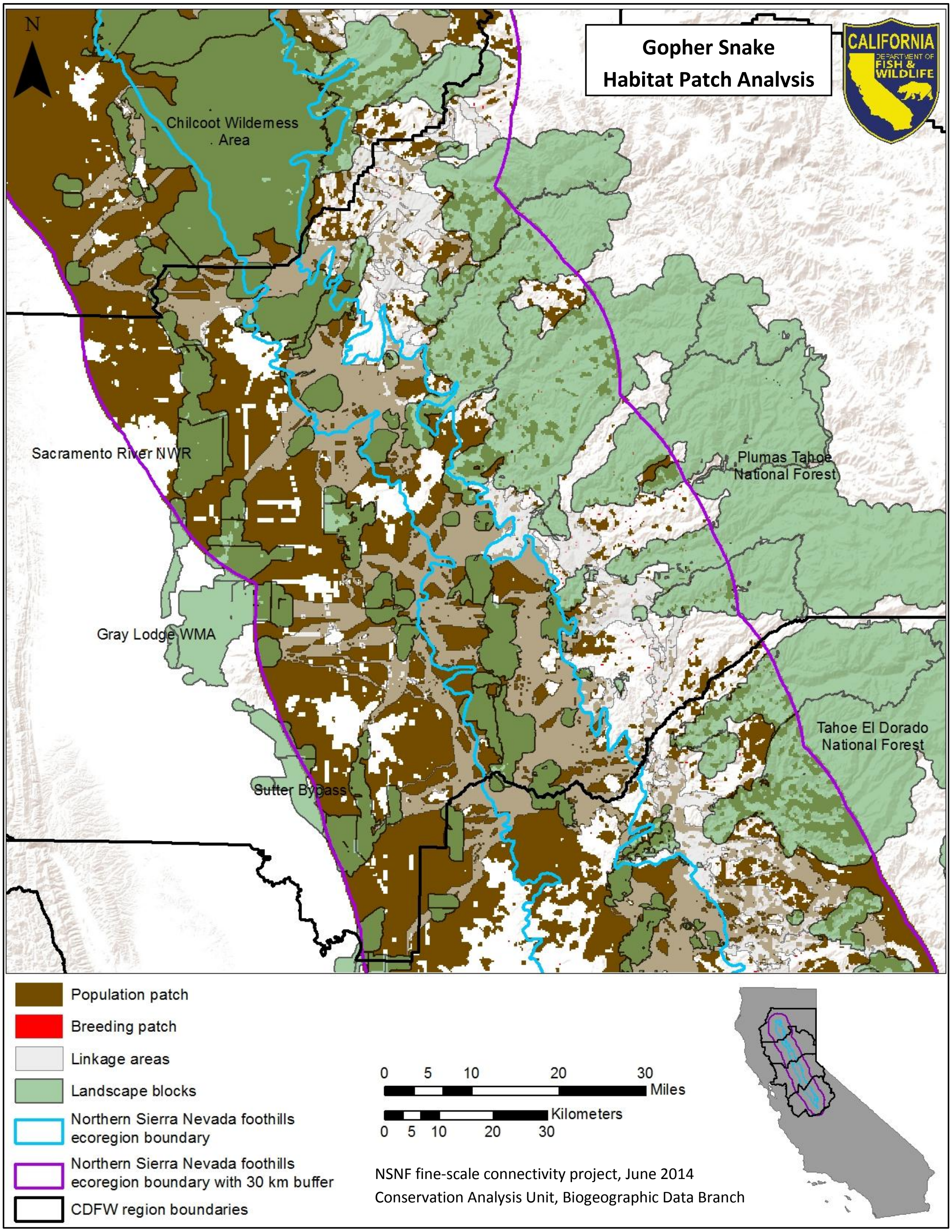


Figure S-65. Habitat patch analysis for the gopher snake (*Pituophis catenifer*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

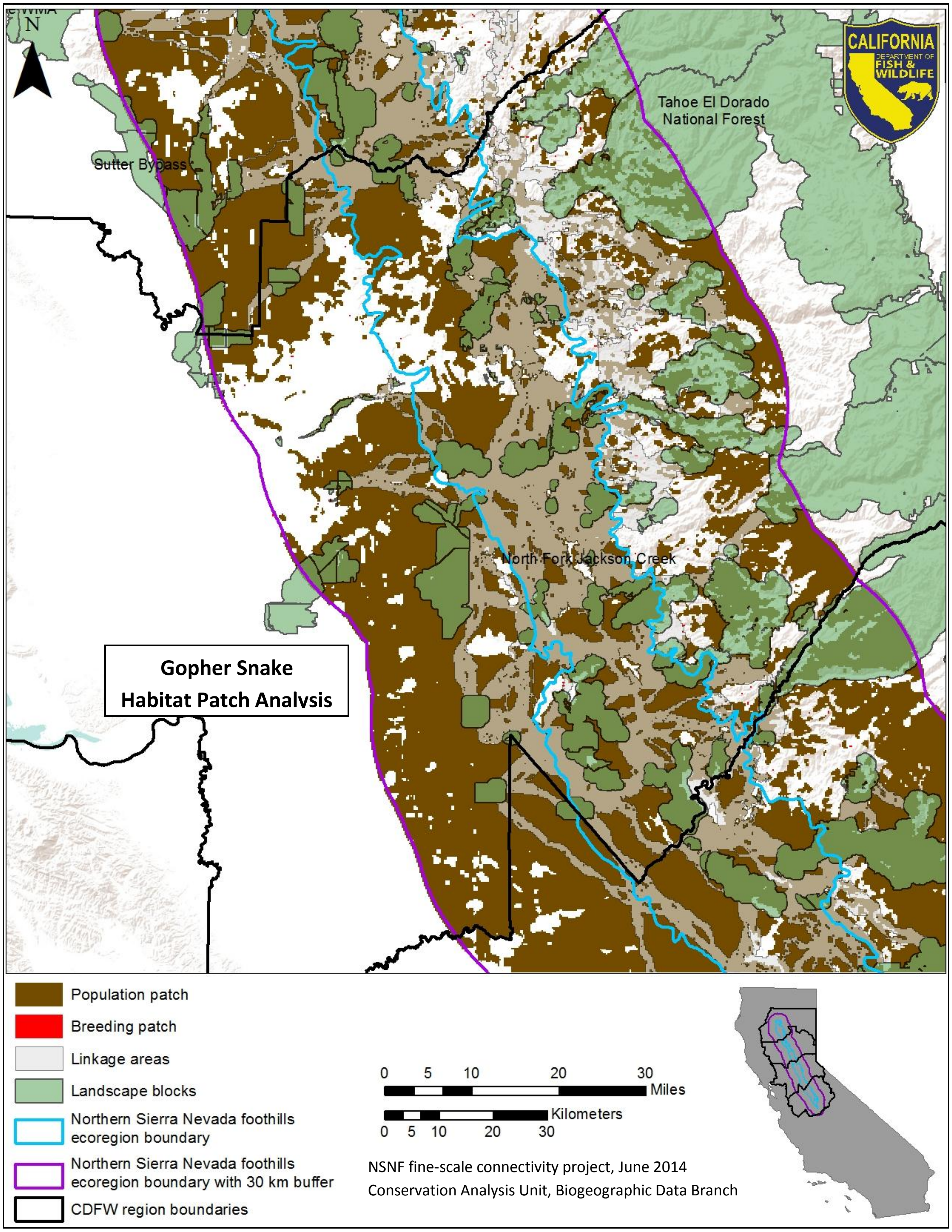


Figure S-66. Habitat patch analysis for the gopher snake (*Pituophis catenifer*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

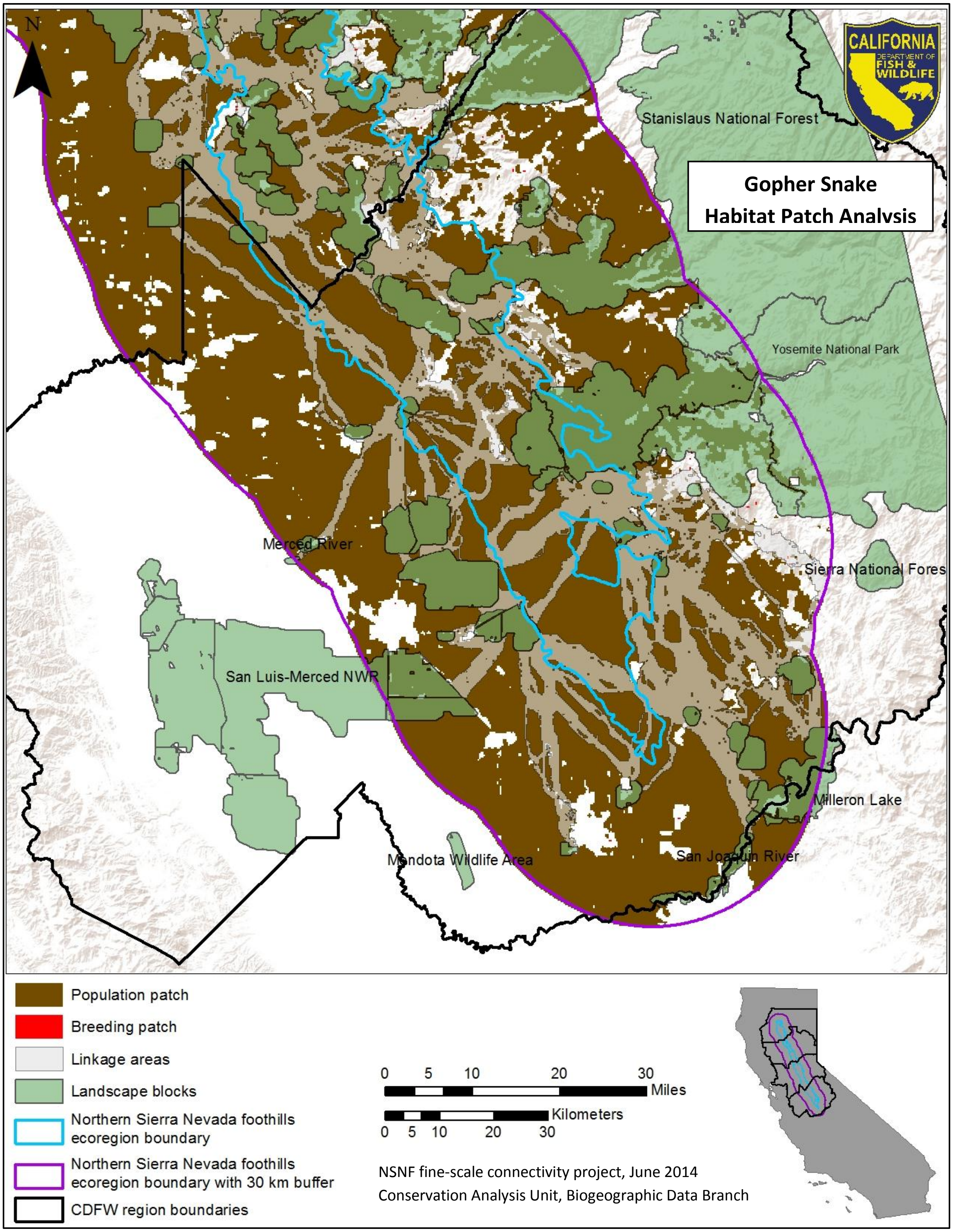


Figure S-67. Habitat patch analysis for the gopher snake (*Pituophis catenifer*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

Gray fox (*Urocyon cinereoargenteus*)

Focal species selection: The gray fox is an uncommon to common permanent residents throughout most of the state, and is **area sensitive**. Suitable habitat consists of shrublands, brushy and open-canopied forests, interspersed with riparian areas, providing water. The species dens in natural cavities in rocky areas, snags, logs, brush, slash and debris piles, abandoned burrows and under buildings. Gray foxes require a permanent water source near their den and probably drink daily (CWHR 2008).

Habitat Model: The final three habitat suitability models developed for gray fox were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 240 location points to train each model, 60 to test each model, and 9923 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Near Davis, California, Fueller (1978) found that four females had an average home range of 1.2 km^2. In Wisconsin, home ranges varied from 0.13 to 3.1 km^2 (CWHR 2008). In Florida, home ranges averaged 7.7 km^2 (CWHR 2008). Minimum breeding patch size used was 120 ha; minimum population patch size was 600 ha.

Dispersal/Migration: Gray fox is a non-migratory species. We used a dispersal distance of 10.6 km (Van Vuren 1998).

Results and Discussion: The selected gray fox habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.50. The model predicted 4,345,219.1 ha of suitable habitat. The patch analysis identified 273 breeding patches covering 55,781.6 ha and 162 population patches covering 1,172,146.8 ha. We identified 85 gray fox least-cost corridors. Habitat patches covered 79.1% of the total corridor area. The elevation ranged from 15 m to 2,259 m. The least-cost corridors covered 385,407.5 ha of land, of those 12.7% were designated as GAP 1, 2 or 3 lands or in conservation easements, and 87.7% were private lands. Gray fox corridors covered many different vegetation types: 47% of corridors were in oak woodland, 13% in hardwood, 11% in chaparral and 9% in grassland. Gray fox habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 49.6% of habitat area in the corridors had high predicted suitability, 28% medium and 22.4% low.

Potential habitat for the gray fox is scattered throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region. Twenty of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat is limited to the foothills in this region of the study area. Habitat patches are scattered throughout the foothills but are within the gray foxes dispersal distance. Twenty-four of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat is scattered in this region. Twenty-six of the corridors are in this region of the study area and capture most of the habitat patches.

Region 4: Habitat is limited to foothills and eastern side in this region of the study area. Habitat patches are fairly continuous. Thirty-two of the corridors are in this region of the study area and capture most of the habitat patches.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.50	n/a	4,345,219.1	1,263,903.9	1,551

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
69.5	18.0	12.5

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
85	79.1	22.4	28	49.6

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
2.9	13.8	35.2	8.9

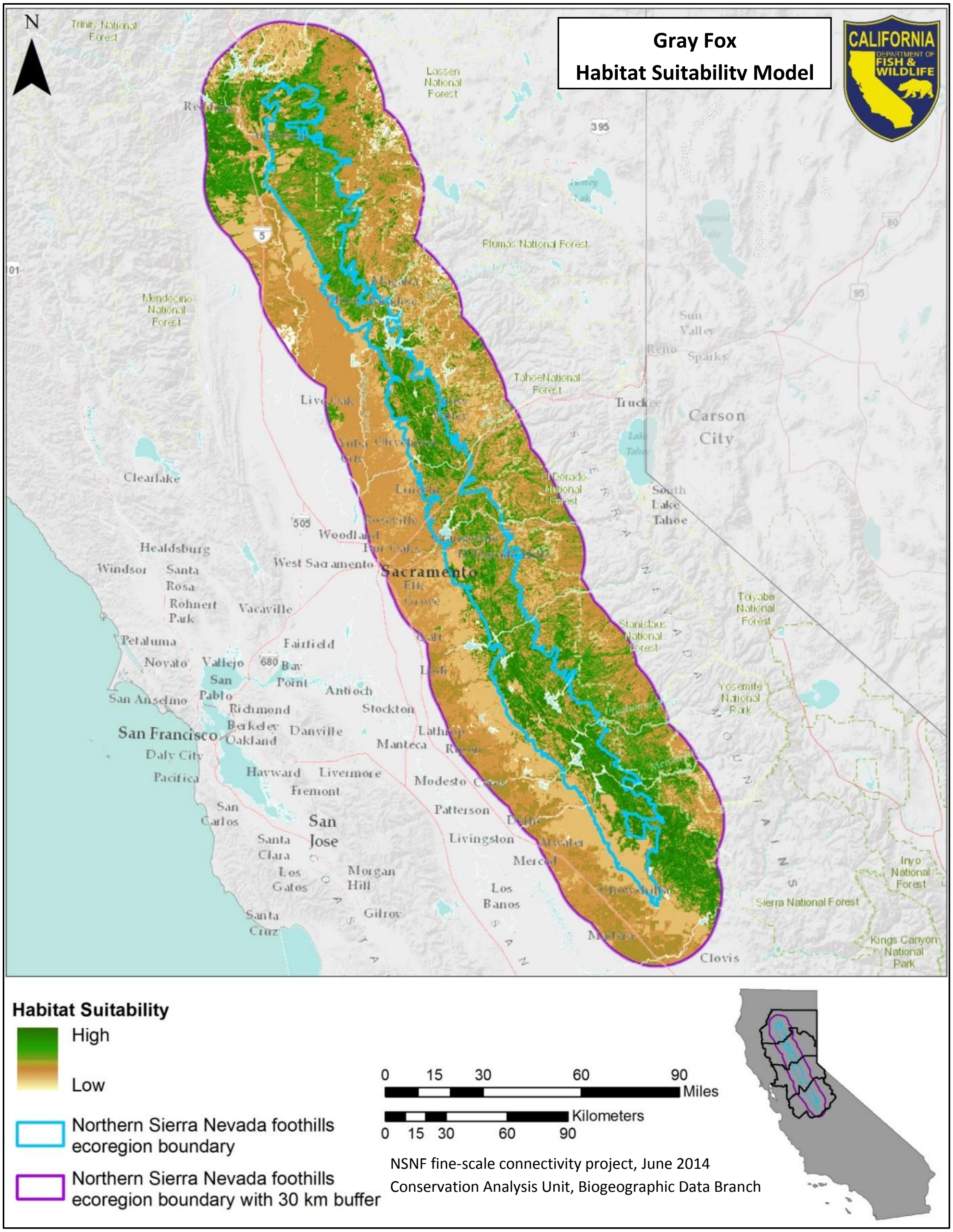


Figure S-68. Predicted habitat suitability for the gray fox (*Urocyon cinereoargenteus*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes**.**

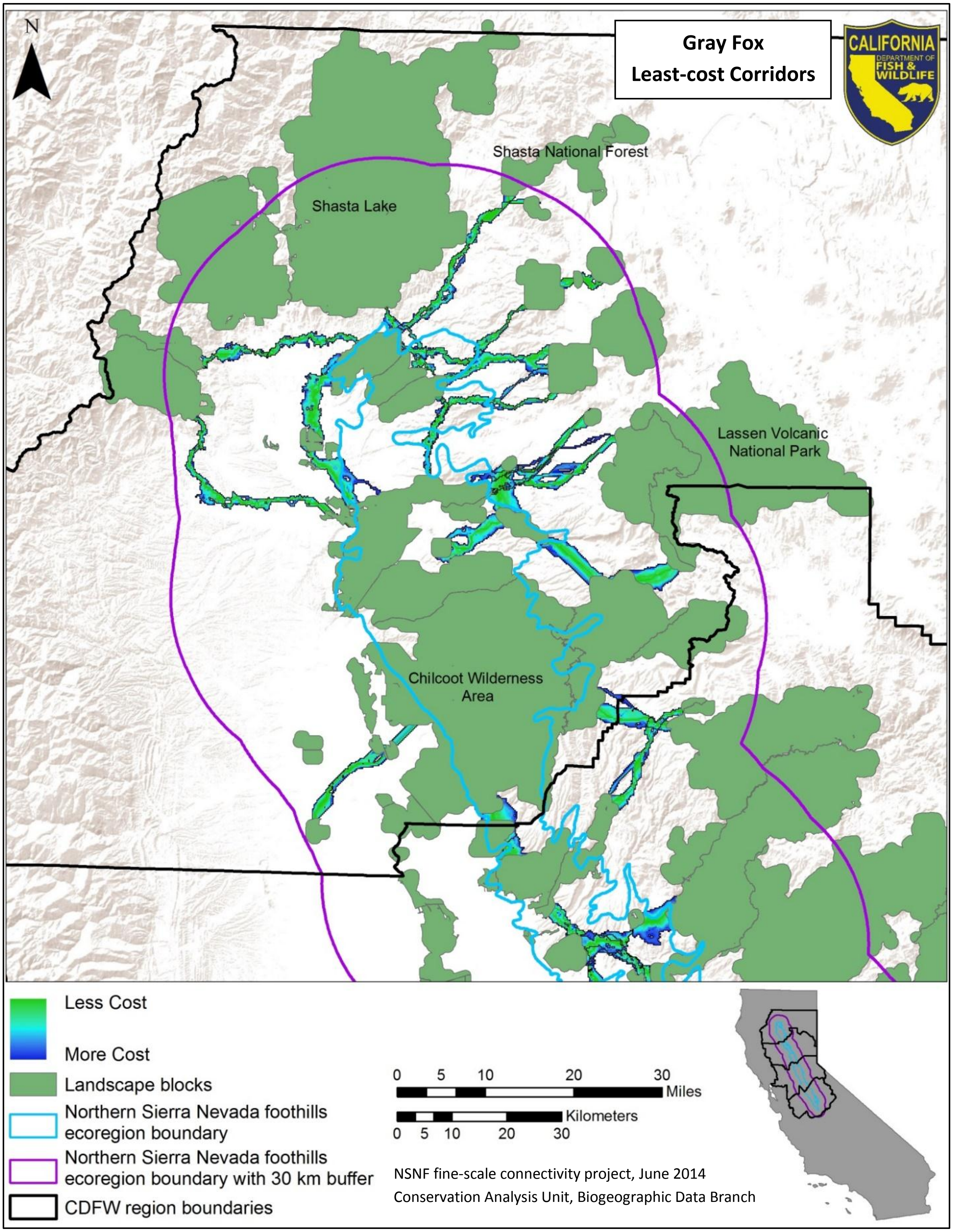


Figure S-69. Least-cost corridor analysis for the gray fox (*Urocyon cinereoargenteus*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

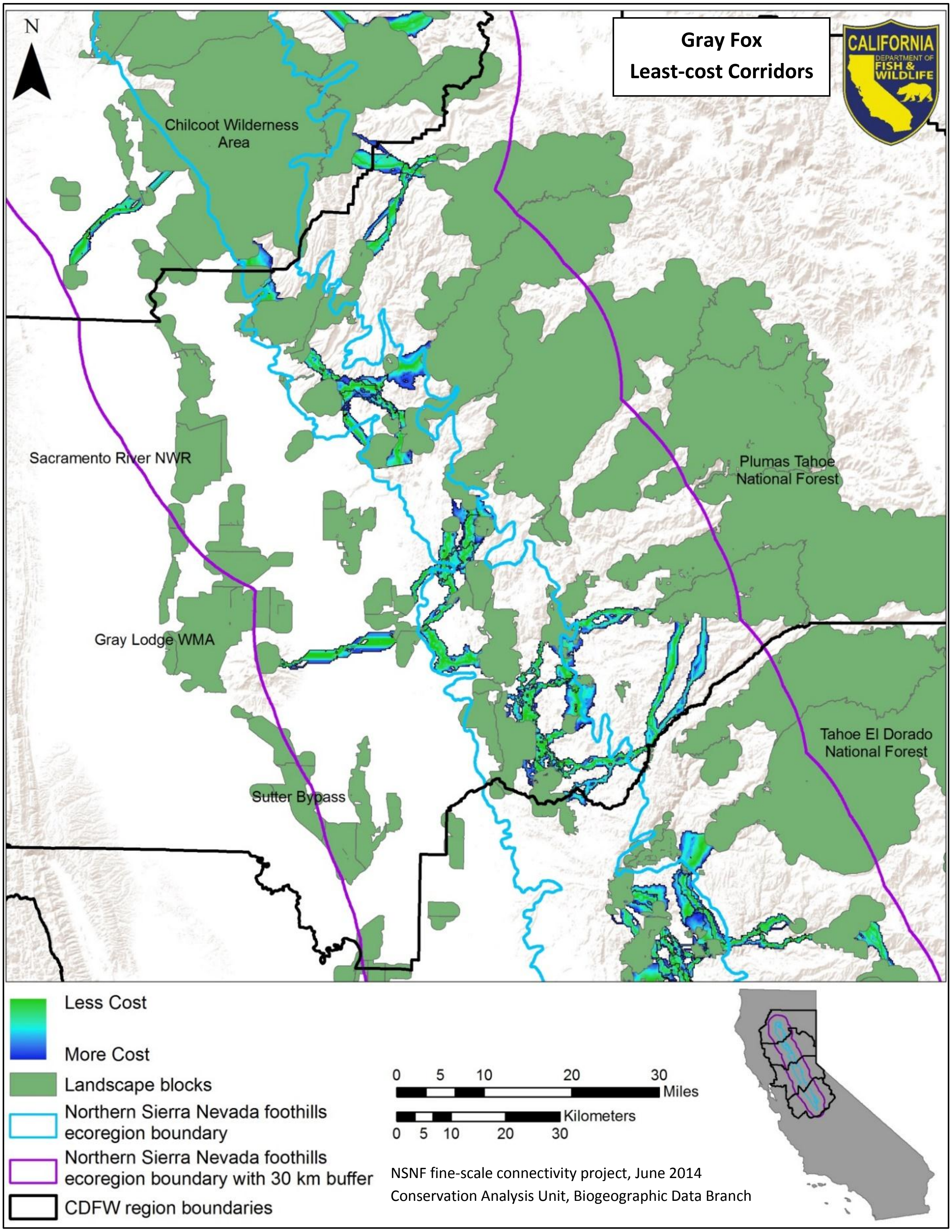


Figure S-70. Least-cost corridor analysis for the gray fox (*Urocyon cinereoargenteus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

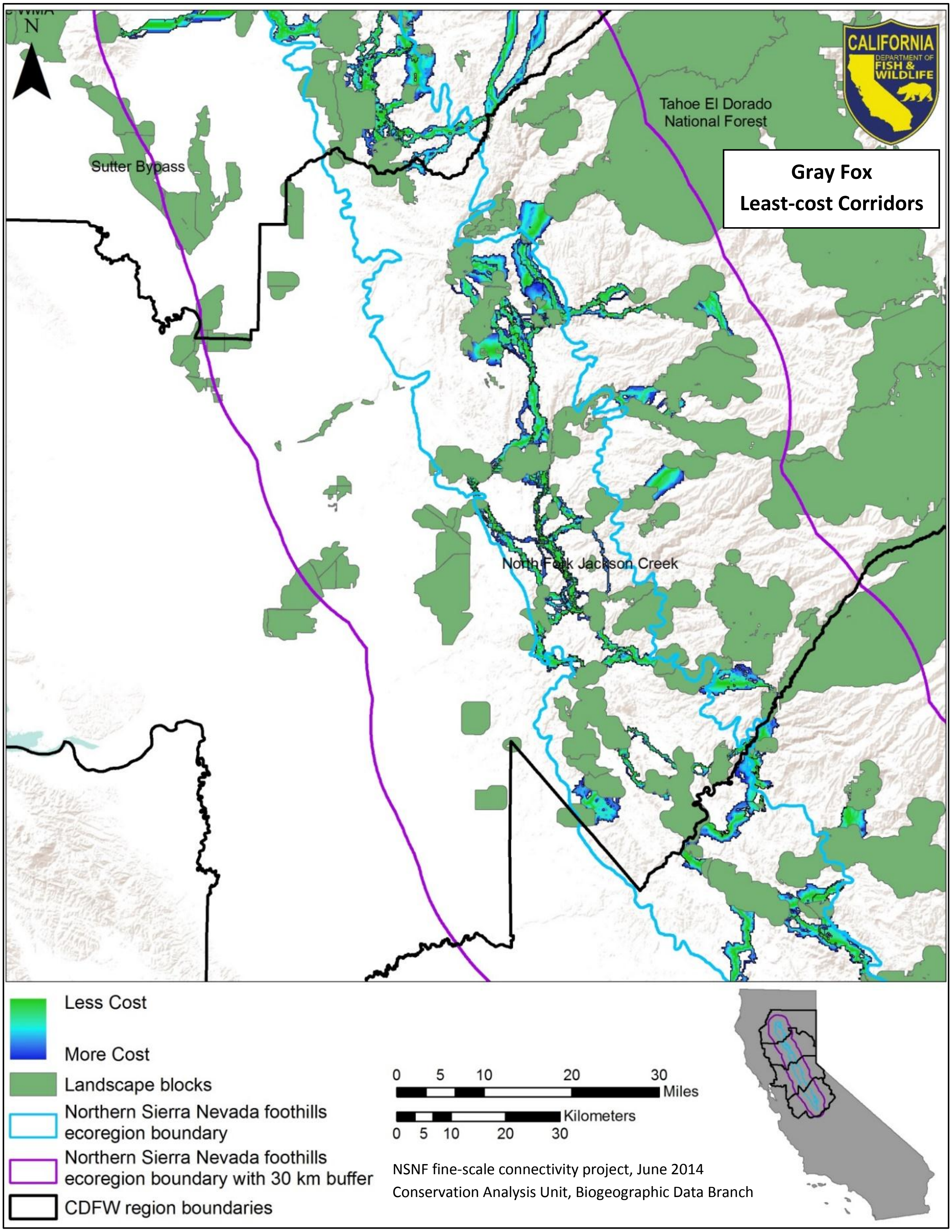


Figure S-71. Least-cost corridor analysis for the gray fox (*Urocyon cinereoargenteus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

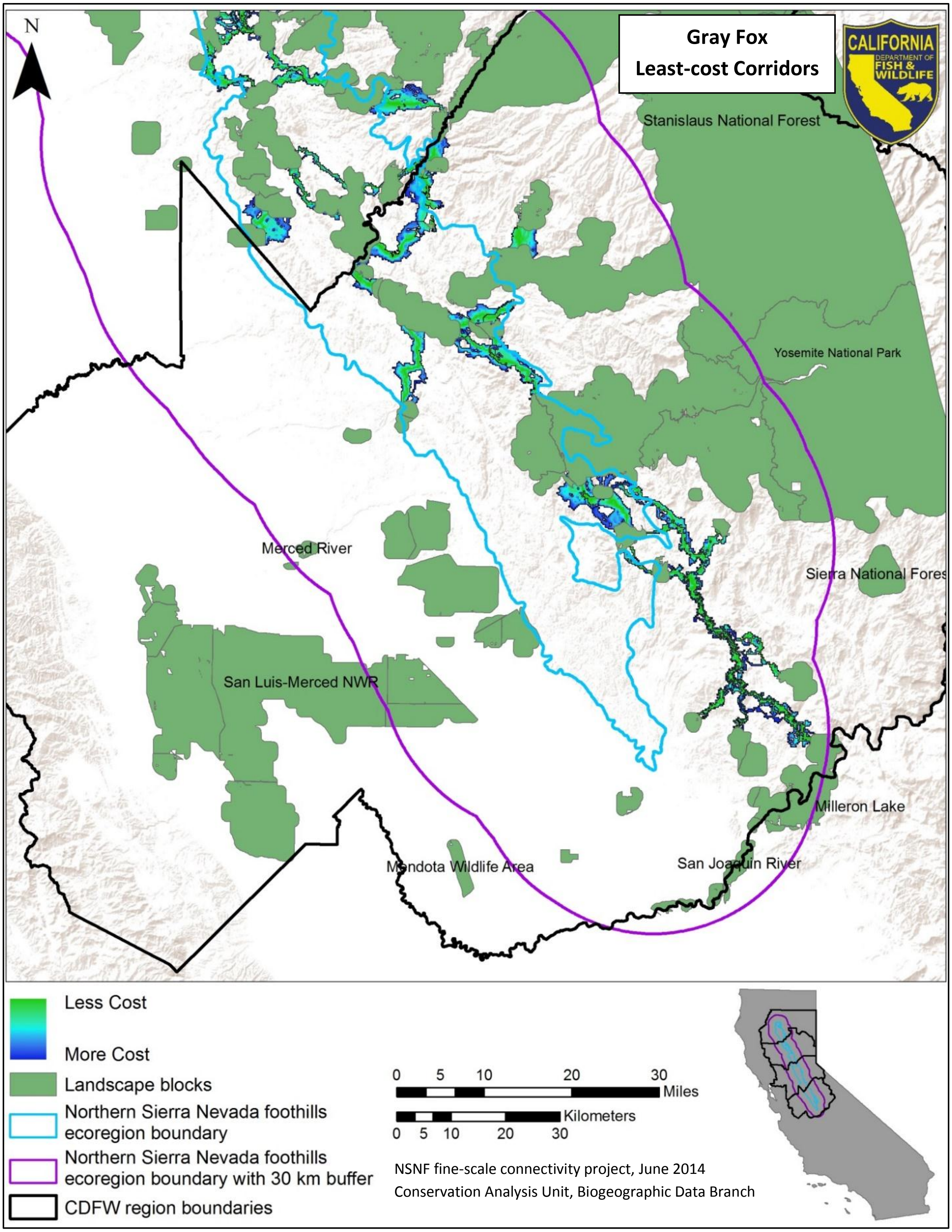


Figure S-72. Least-cost corridor analysis for the gray fox (*Urocyon cinereoargenteus*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Heermann's Kangaroo Rat (*Dipodomys heermanni*)

Focal species selection: Heermann's kangaroo rats are distributed in the foothills from Kern County to El Dorado County, as well as in the San Joaquin Valley and the Central Coast Ranges (CWHR 2008). The species is common in annual grassland, coastal scrub, mixed and montane chaparral and early successional stages (sparse to open canopy) of valley foothill hardwood and valley foothill hardwood-conifer habitats. It occurs on hillsides, knolls and ridges with sparse to moderate chaparral cover (CWHR 2008). The species frequents dry, grassy plains with partly open, friable soils. Well drained soil is a requirement. Its preferred burrowing substrate is fine, deep soil (Tappe 1941), although shallow, coarse and rocky soil also may be used. In rocky soils, it may rely on abandoned burrows (Fitch 1948). Hermann's kangaroo rats apparently can survive without drinking water, and probably receive water from food and dew under natural conditions (CWHR 2008). The Heermann's kangaroo rat was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for Heermann's kangaroo rat were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 291 location points to train each model, 73 to test each model, and 9893 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range. In San Joaquin Valley, densities of up to 17/ha were reported, but annual fluctuations were great (CWHR 2008). Minimum breeding patch size used was 1 ha; minimum population patch size was 8 ha.

Dispersal/Migration: Species is non migratory; most marked individuals ranged within 30-120 m of burrow over the course of a year or more (Fitch 1948). Maximum dispersal distance used was 250 m.

Results and Discussion: The selected Heermann's kangaroo rat habitat suitability model was Maxent scenario 5. The model performed well with an AUC of 0.95. The mean probability threshold was 0.10 predicting 1,033,284.6 ha of suitable habitat. The patch analysis identified 207 population patches covering 830,559.7 ha. Sixty-two of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages.

Habitat patches covered 87.8% of the total corridor area. Heermann's kangaroo rat habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 6.2% of habitat area in the corridors had high predicted suitability, 34.5% medium and 59.3% low.

Potential habitat for Heermann's kangaroo rat is limited to the southern regions of the study area.

Region 2 South: Habitat is limited to the foothills in this region of the study area. Habitat patches from the Crevis Creek block are fairly continuous and are captured by most linkages.

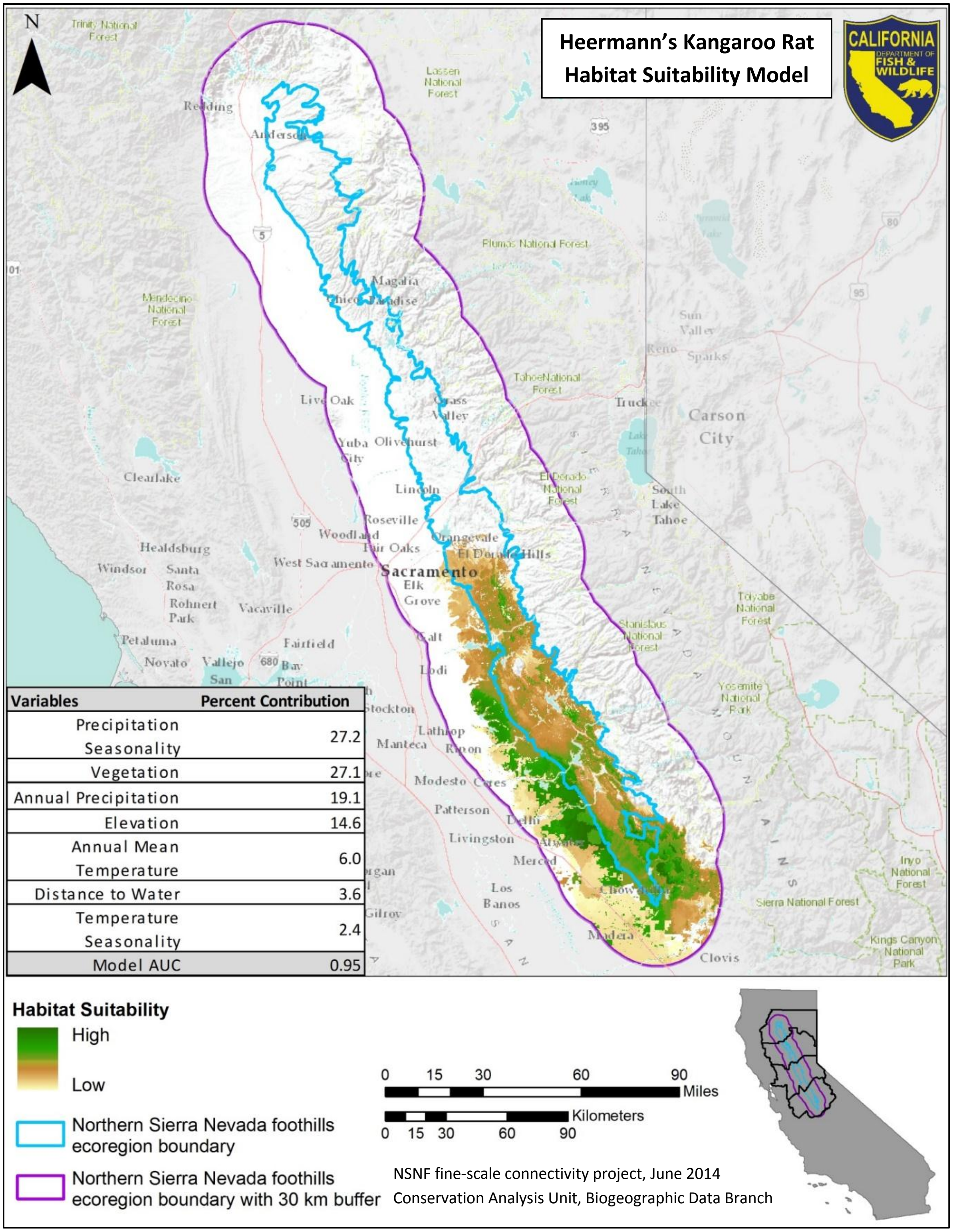
Region 4: Habitat is fairly continuous throughout the center of this region of the study area. Habitat patches on the western side of the region near the Merced River and San Luis-Merced NWR blocks are isolated from the main foothill blocks. Scattered habitat patches near the Medera block are also isolated.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.95	0.1	1,033,284.6	830,559.7	207

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
64.3	29.7	6.1

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
62	87.8	59.3	34.5	6.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
42.3	53.4	46.8	45.9



Variables	Percent Contribution
Precipitation Seasonality	27.2
Vegetation	27.1
Annual Precipitation	19.1
Elevation	14.6
Annual Mean Temperature	6.0
Distance to Water	3.6
Temperature Seasonality	2.4
Model AUC	0.95

Figure S-73. Predicted habitat suitability for the Heermann's kangaroo rat (*Dipodomys heermanni*). Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water, and a 15 class vegetation layer.

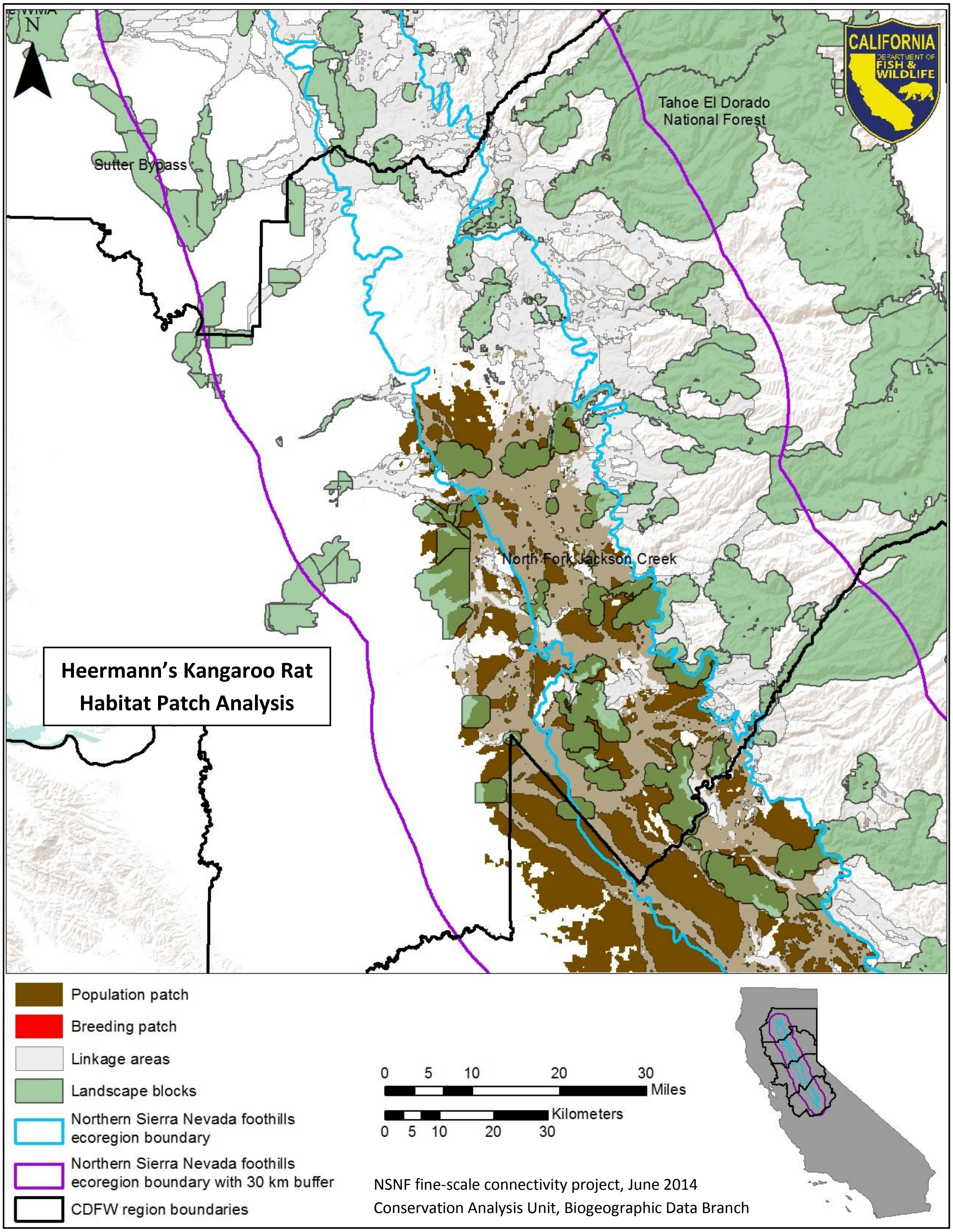


Figure S-74. Habitat patch analysis for the Heermann's kangaroo rat (*Dipodomys heermanni*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >8 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

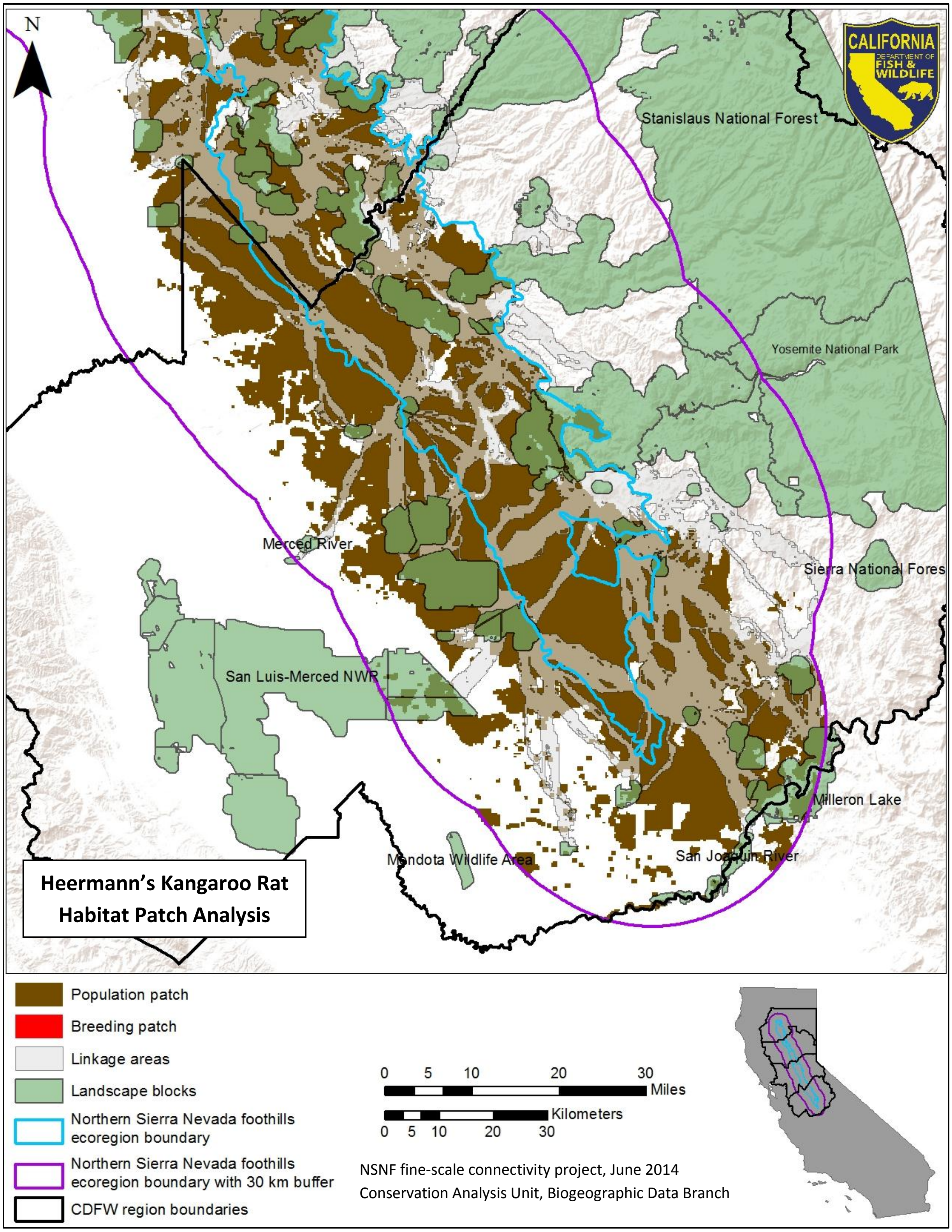


Figure S-75. Habitat patch analysis for the Heermann's kangaroo rat (*Dipodomys heermanni*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >8 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

Lark sparrow (*Chondestes grammacus*)

Focal species selection: Lark sparrows are common to fairly common resident in the lowlands and foothills throughout much of California. In the northeast and Owens Valley, it departs for winter. It breeds only locally in southern deserts, but is somewhat more widespread in winter. The species frequents sparse valley foothill hardwood, valley foothill hardwood-conifer, open mixed chaparral and similar brushy habitats and grasslands with scattered trees or shrubs. In woodlands, it prefers younger stages and hardwoods (mostly oaks) rather than conifers. The species is most common around margins of Central Valley, in bordering foothills, and inner coastal ranges (CWHR 2008). The lark sparrow probably requires water; it drinks and baths frequently (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the lark sparrow was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for lark sparrow were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 2713 location points to train each model, 679 to test each model, and 9307 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality) elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: The summer home range of a pair in Kansas was 6.1 ha (Fitch 1958). Minimum breeding patch size used was 6 ha; minimum population patch size was 150 ha.

Dispersal/Migration: It is not migratory over most of its California range, or at least present year-round (CWHR 2008). The maximum dispersal distance used was 200 km.

Results and Discussion: The selected lark sparrow habitat suitability model was Maxent scenario 7. The model performed well with an AUC of 0.81. The mean probability threshold was 0.32 predicting 2,899,211.1 ha of suitable habitat. The patch analysis identified 911 breeding patches covering 36,667.9 ha and 285 population patches covering 2,918,715.6 ha. Two hundred forty-two of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 88% of the total corridor area. Lark sparrow habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 45.6% of habitat area in the corridors had high predicted suitability, 42.3% medium and 12.1% low.

Potential habitat for lark sparrow is and widespread throughout the foothills and on the western side of the study area; potential habitat is scattered on the eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with scattered patches within the dispersal distance of lark sparrow on the eastern side near Shasta NF and Lassen Volcanic National Park. The linkages capture most of the habitat patches in the north between Chilcoot WA and Shasta Lake.

Region 2 North: Habitat is limited to the foothills and western side in this region with only scattered patches on the eastern side of the study area that are within landscape blocks. Habitat patches on the western side near the Sacramento River NWR may become more isolated from the Chico block due to urbanization around the City of Chico. Habitat patches are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is widespread in the foothill area and on the western side of the study area, with only scattered patches on the eastern side of the study area. Habitat patches are captured by most linkages.

Region 4: Habitat is fairly continuous in this region of the study area. Habitat patches are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.81	0.32	2,899,211.1	2,955,383.7	1,196

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
26.8	44.7	28.5

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
242	88.0	12.1	42.3	45.6

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
24.1	50.4	85.4	53.3

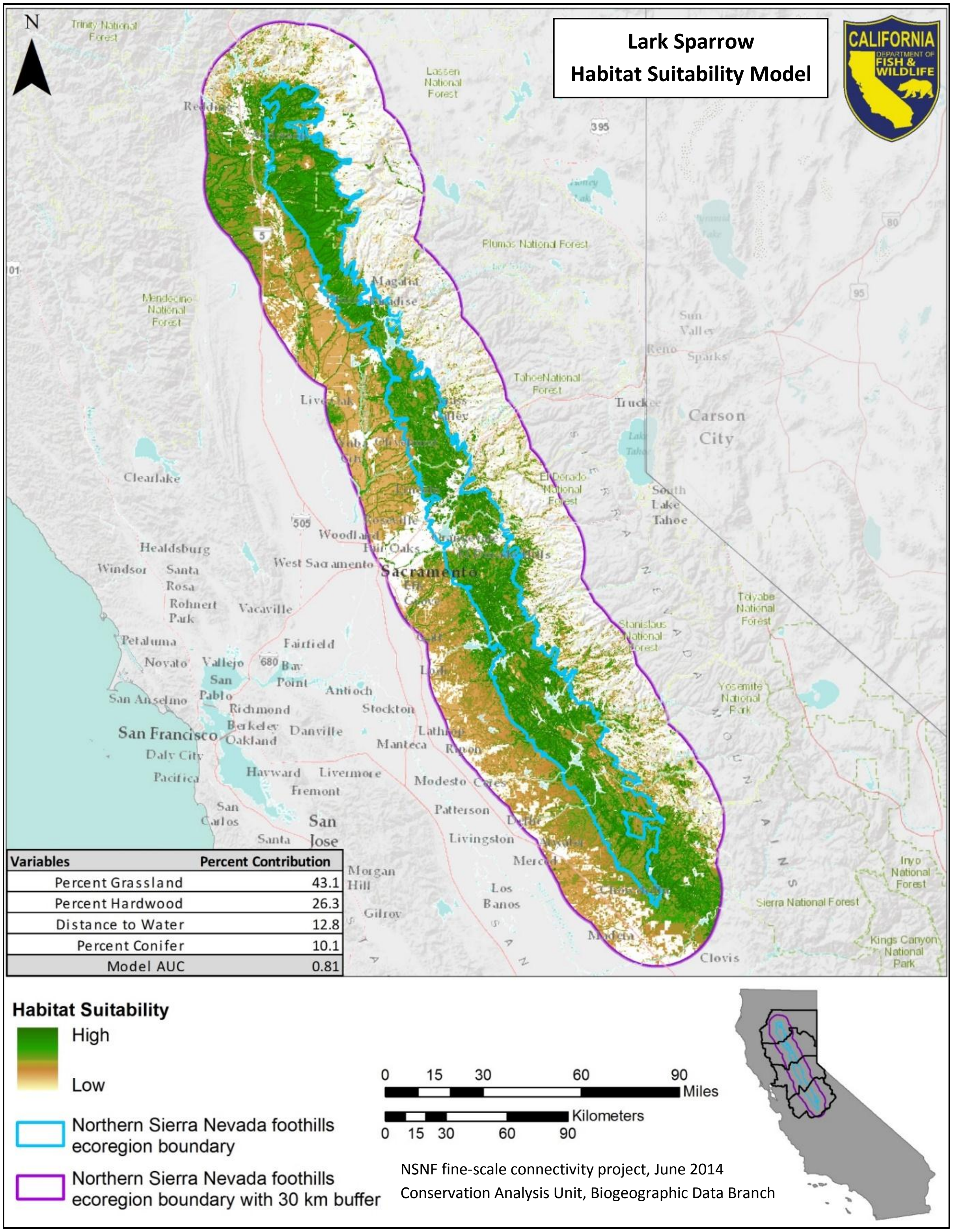


Figure S-76. Predicted habitat suitability for the lark sparrow (*Chondestes grammacus*). Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub).

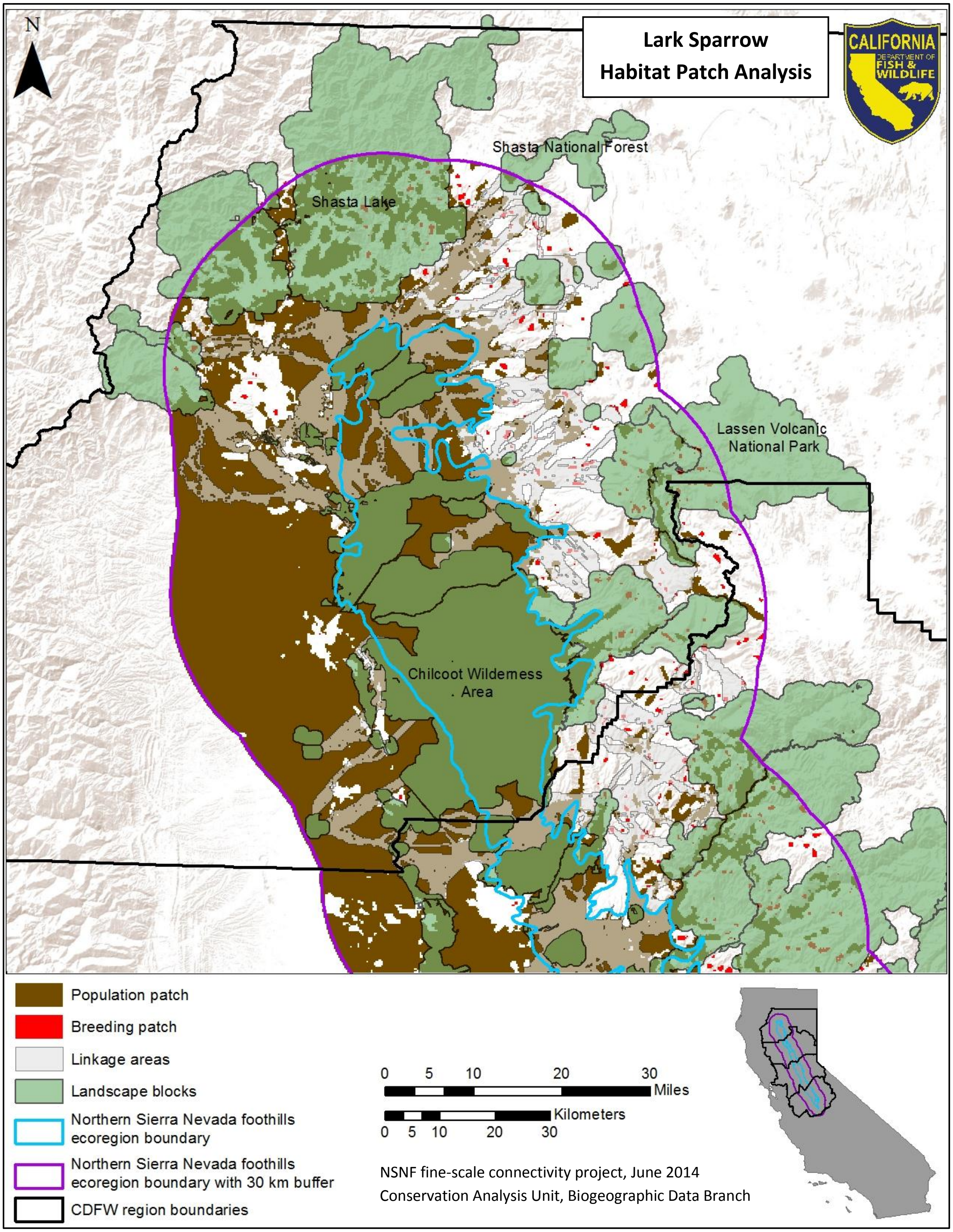


Figure S-77. Habitat patch analysis for the lark sparrow (*Chondestes grammacus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >150 ha; breeding patches were contiguous areas of suitable habitat >6 ha.

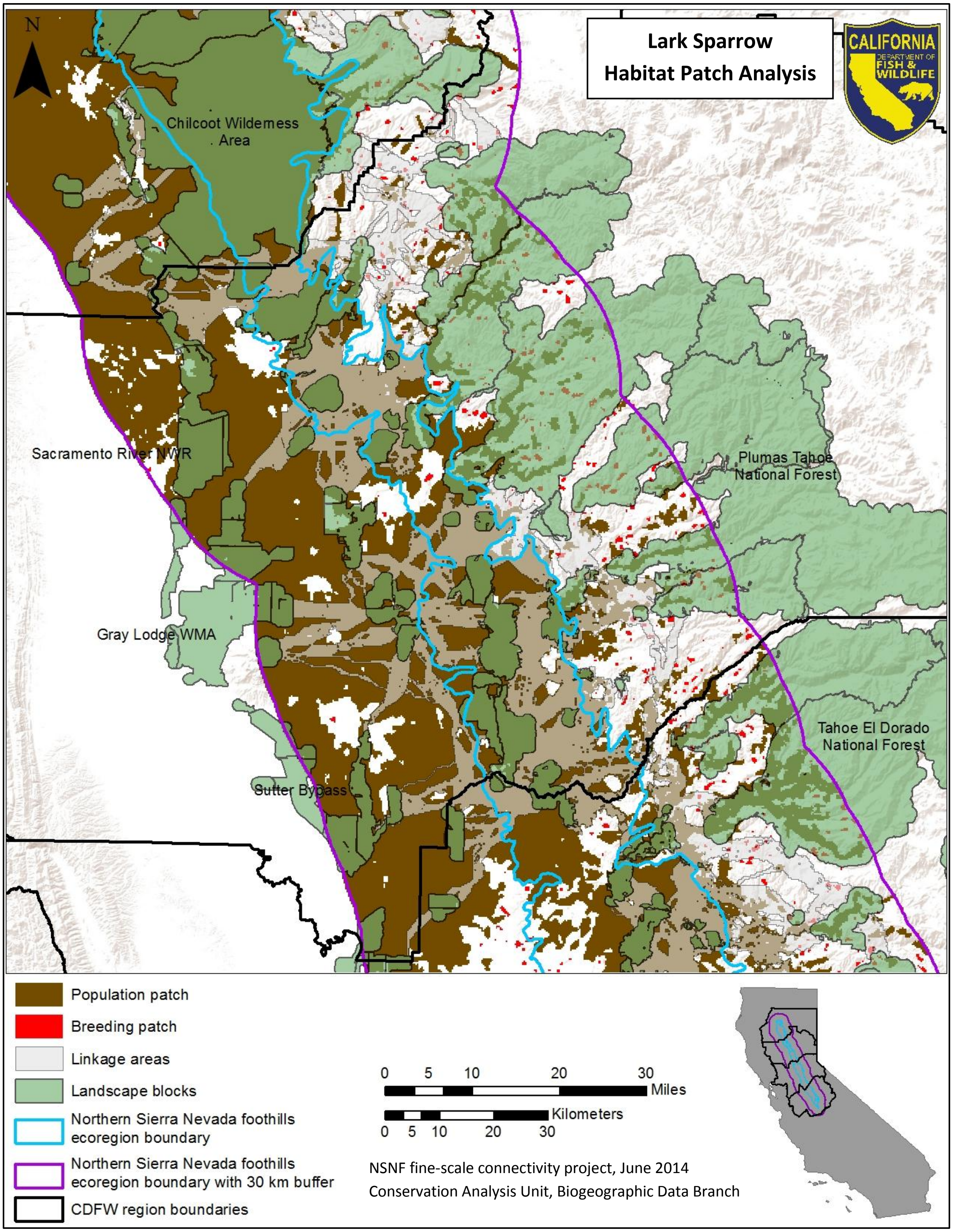


Figure S-78. Habitat patch analysis for the lark sparrow (*Chondestes grammacus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >150 ha; breeding patches were contiguous areas of suitable habitat >6 ha.

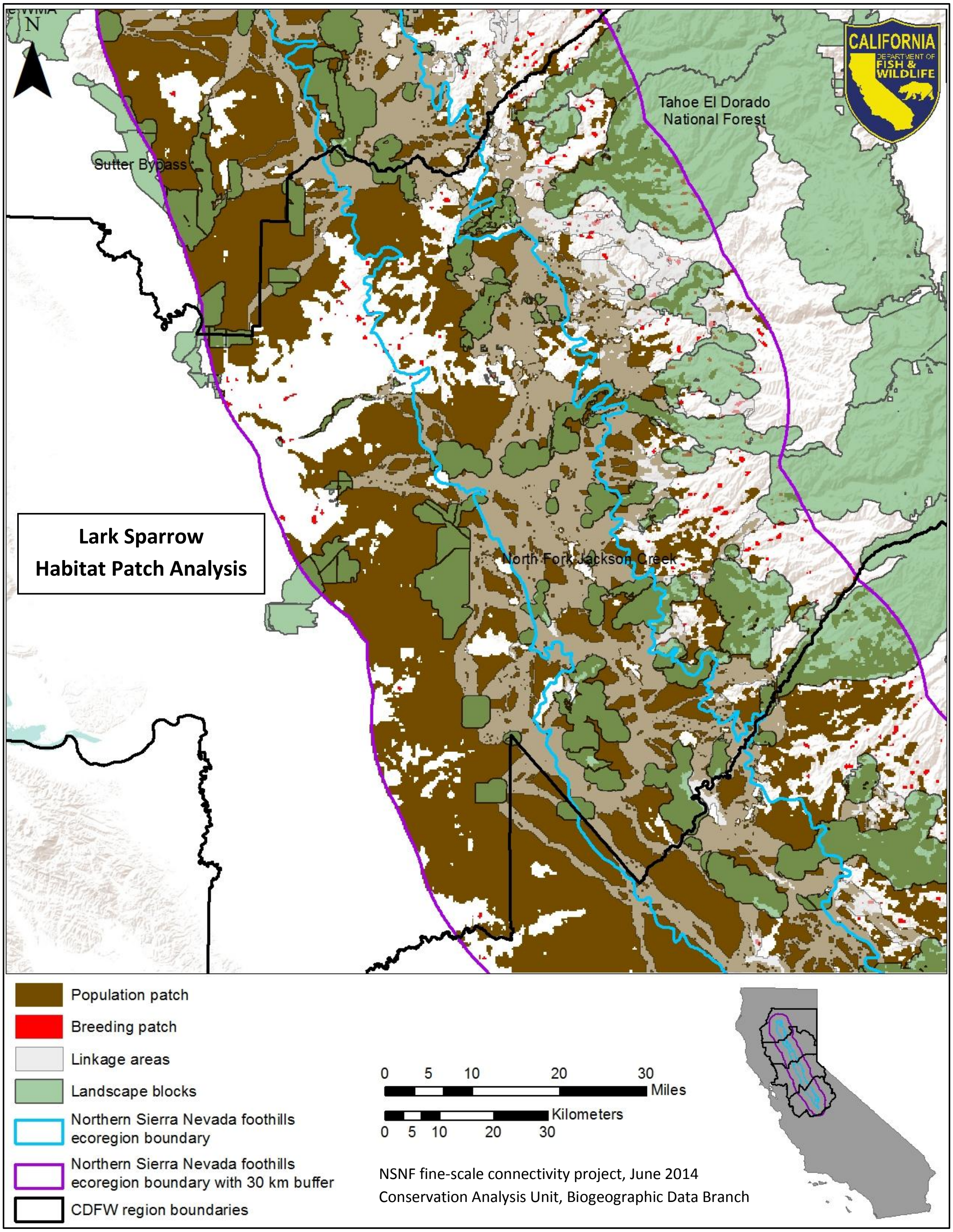


Figure S-79. Habitat patch analysis for the lark sparrow (*Chondestes grammacus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >150 ha; breeding patches were contiguous areas of suitable habitat >6 ha.

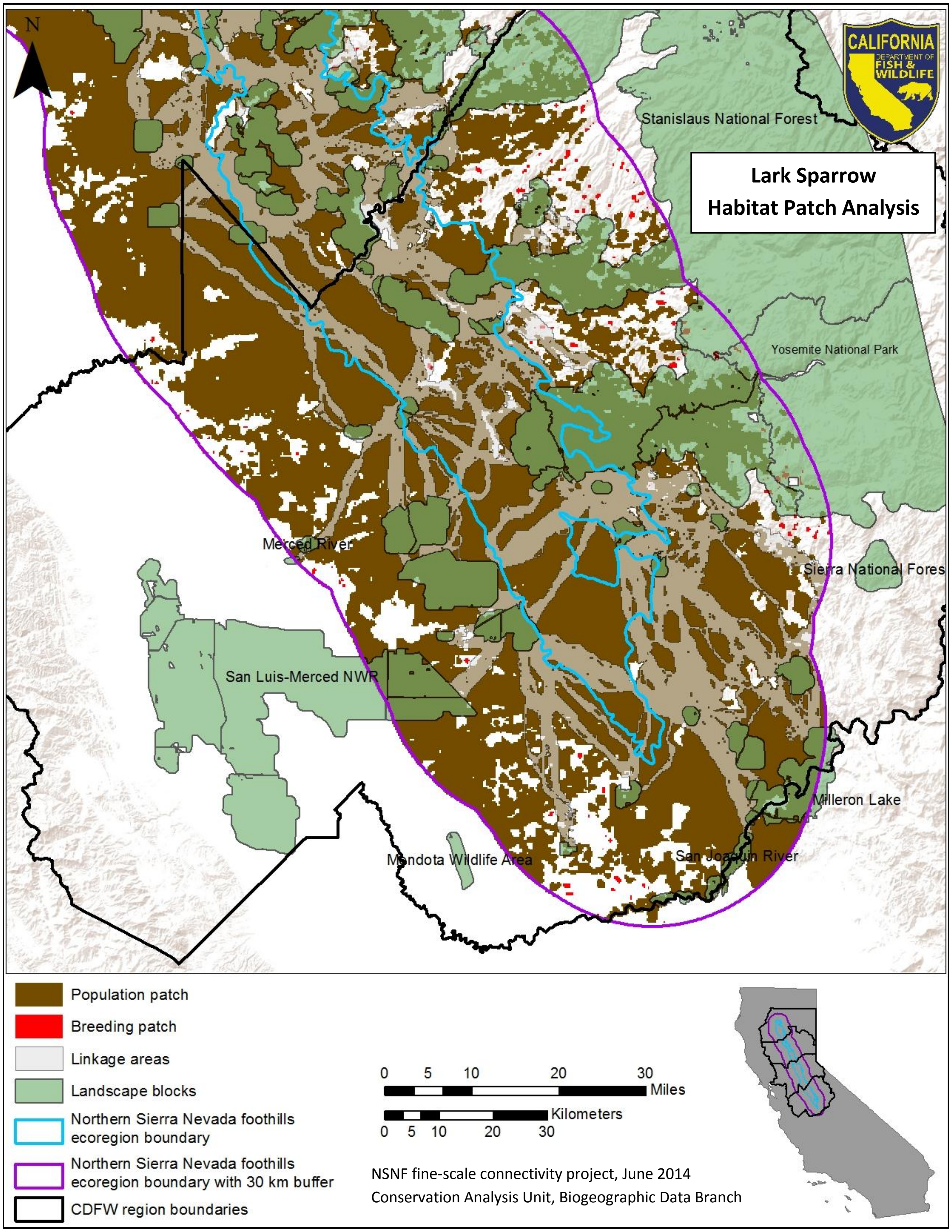


Figure S-80. Habitat patch analysis for the lark sparrow (*Chondestes grammacus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >150 ha; breeding patches were contiguous areas of suitable habitat >6 ha.

Limestone salamander (*Hydromantes brunus*)

Focal species selection: The limestone salamander is a highly restricted species, sometimes associated with limestone outcrops, known primarily from the mixed chaparral habitats along the Merced River and its tributaries in Mariposa County (CWHR 2008). The limestone salamander is a State-listed Threatened species (CNDDB 2014). During periods of surface activity, early November to the end of March (Tordoff 1980), this species is found under surface objects on steep north and east-facing slopes. California buckeye may serve as an indicator species for optimal habitat (CWHR 2008). It is found mainly in mixed chaparral habitats during moist periods; and in limestone caverns, deep talus formations and rock fissures during the remainder of the year (CWHR 2008). Water needs are probably met by rains during the period of surface activity, and the remainder of the year by subterranean sources (CWHR 2008). The limestone salamander was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for limestone salamander were the expert opinion CWHR Bioview, and Maxent scenarios 7g and 9g. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 41 location points to train each model, 11 to test each model, and 9962 background points. Environmental variables for the Maxent scenario 7g model included geology, elevation, distance to water and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9g model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), geology, elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Little information known about home range. Minimum breeding patch size used was 1 ha; minimum population patch size was 1 ha.

Dispersal/Migration: The species is non migratory. Maximum dispersal distance used was 100 m.

Results and Discussion: The selected limestone salamander habitat suitability model was Maxent scenario 9g. The model performed well with an AUC of 0.99. The mean probability threshold was 0.10 predicting 18,136 ha of suitable habitat. The patch analysis identified 5 population patches covering 18,136.9 ha. Some population patches fell within landscape blocks, but none of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance for the species.

Potential habitat for the limestone salamander is highly restricted on the south-eastern side of the study area.

Region 4: Limestone salamander habitat was predicted in the foothills along the Merced River and its tributaries just east of Lake McClure. Habitat patches were present in the Yosemite-Stanislaus National Forest block. Although potential suitable habitat was predicted within the least-cost union corridor between this block and the Clarks Valley-Snow Creek block, the habitat patches were not within the maximum dispersal distance for the species.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.99	0.10	41,079	18,136.9	5

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
81.4	14.1	4.5

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
0	n/a	n/a	n/a	n/a

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
n/a	n/a	n/a	n/a

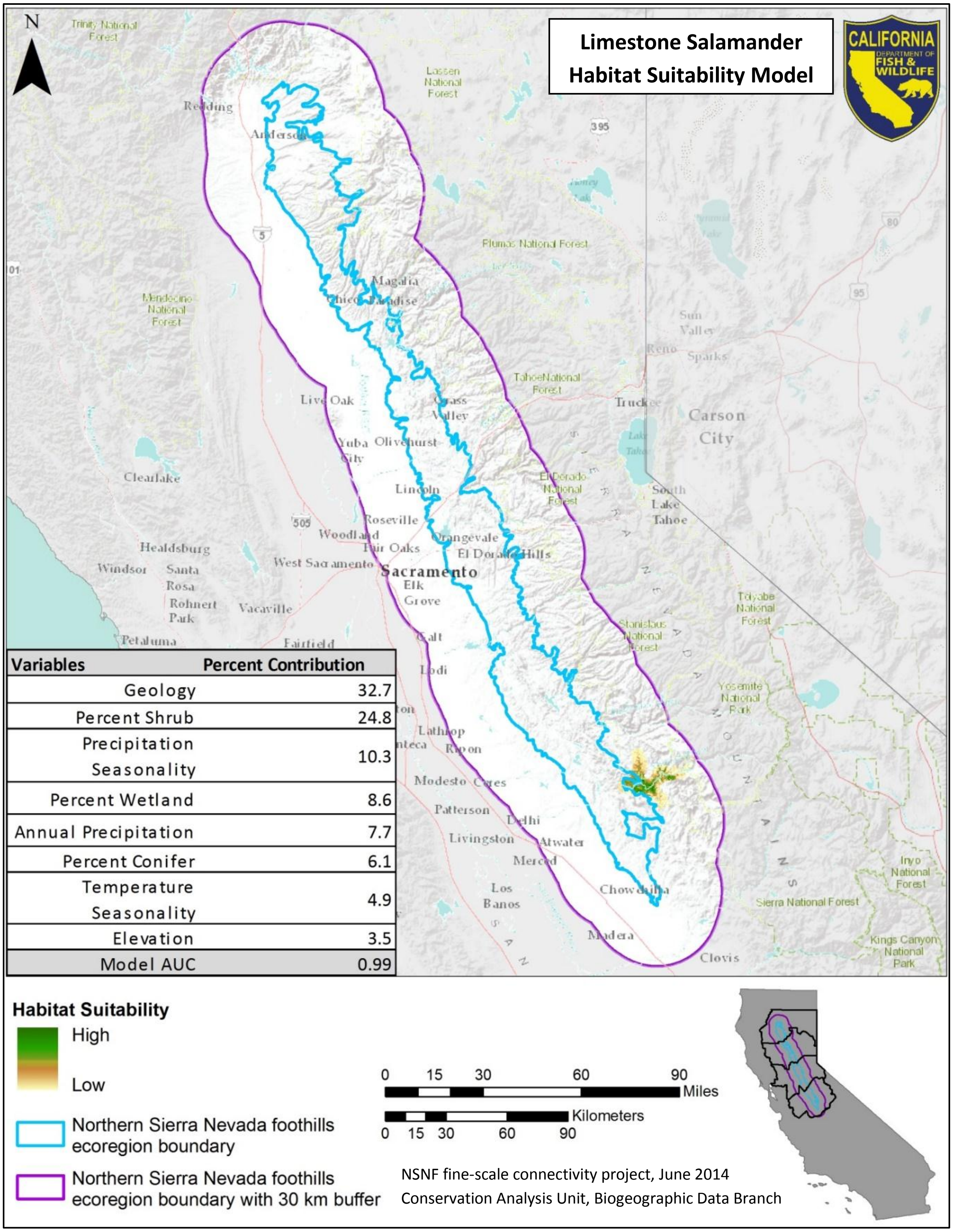


Figure S-81. Predicted habitat suitability for the limestone salamander (*Hydromantes brunus*). Environmental variables for the Maxent scenario 9g included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), geology, elevation, distance to water, and vegetation represented by four continuous variables.

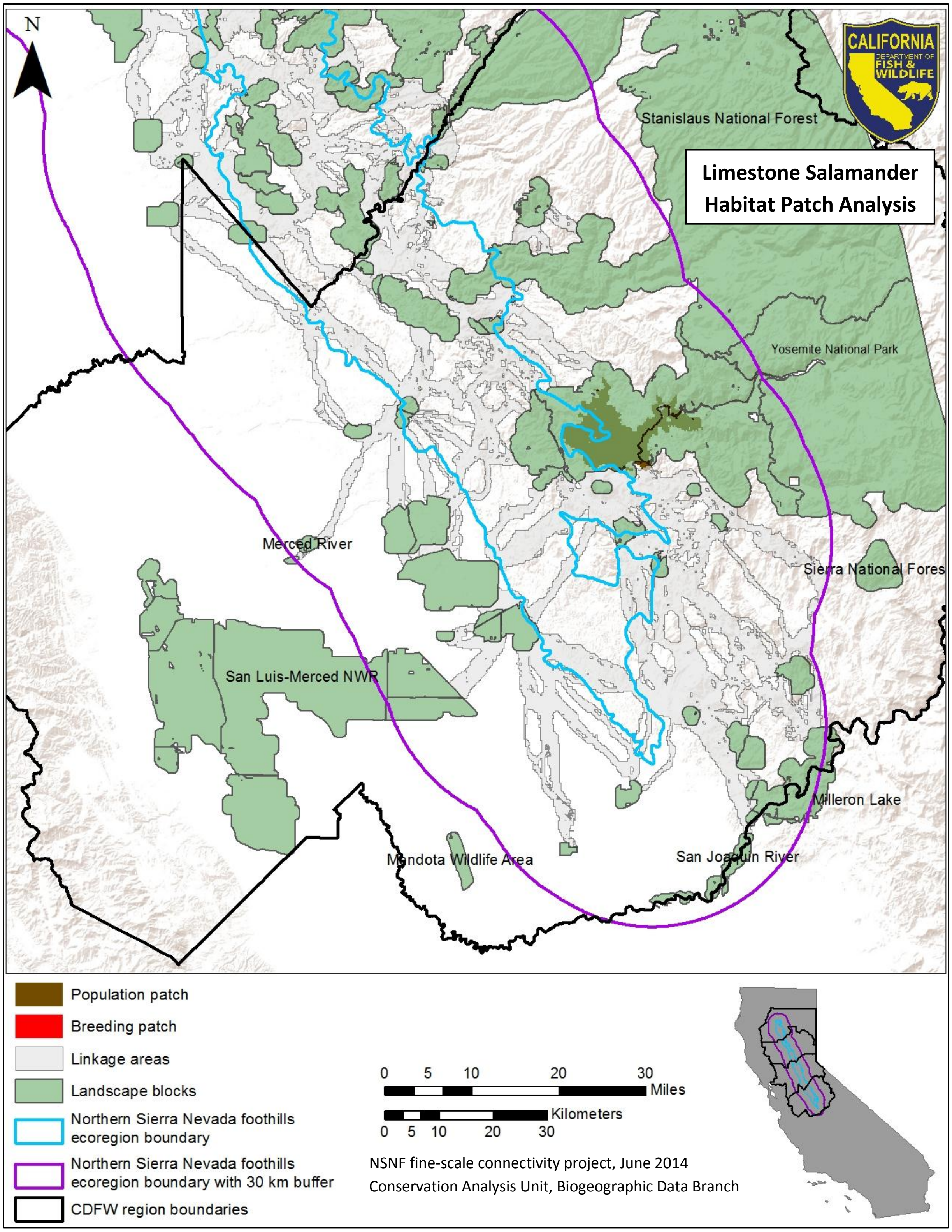


Figure S-82. Habitat patch analysis for the limestone salamander (*Hydromantes brunus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >1 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

Mountain lion (*Puma concolor*)

Focal species selection Mountain lions are widespread, uncommon permanent residents, ranging from sea level to alpine meadows (CWHR 2008). The species is found in nearly all habitats, except xeric regions of the Mojave and Colorado deserts that do not support mule deer populations (CWHR 2008), and croplands in the Central Valley (Ingles 1965). Mountain lions are most abundant in riparian areas and brushy stages of most habitats (CWHR 2008). The species is capable of existing for long periods without drinking water (CWHR 2008). Mountain lions are **area sensitive**, requiring large home ranges.

Habitat Model: The final three habitat suitability models developed for mountain lion were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 194 location points to train each model, 49 to test each model, and 9922 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Male home ranges usually are a minimum of 40 km^2, female home ranges usually are 8-32 km^2 (Russell 1978). Minimum breeding patch size used was 20,000 ha; minimum population patch size was 100,000 ha.

Dispersal/Migration: Seasonal movements within a fixed range commonly are in response to prey movements, following migrating deer herds (CWHR 2008). Maximum dispersal distance used was 274 km.

Results and Discussion: The selected mountain lion habitat suitability model was Maxent scenario 5. The model performed well with an AUC of 0.91. The mean probability threshold was 0.16, predicting 2,864,773.2 ha of suitable habitat. The patch analysis identified 28 breeding patches covering 37,797.7 ha and 65 population patches covering 1,099,729.7 ha. We identified 66 mountain lion least-cost corridors. Habitat patches covered 78.5% of the total corridor area. The majority of corridors were on the eastern side of the study area and ranged in elevation from 102 m to 1,803 m. The least-cost corridors covered 293,729.1 ha of land, of those 17.1% were designated as GAP 1, 2 or 3 lands or in conservation easements, 83.7% are private lands. Mountain lion corridors covered many different vegetation types: 32% of the corridor area was in oak woodland, 19% in hardwood, 13% in mixed conifer and 12% in grassland. Mountain lion habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 51.1% of habitat area in the corridors had high predicted suitability, 36.2% medium and 12.6% low.

Potential habitat for the mountain lion is generally limited to the foothills and eastern section of the study area, except in the north.

Region 1: Ten of the corridors are in this region of the study area and capture most of the habitat patches. Habitat patches near Whiskeytown-Shasta-Trinity NRA block are isolated from other habitat patches.

Region 2 North: Habitat is limited to the foothills and eastern side in this region of the study area, and habitat patches throughout this region are fairly continuous. Twenty-three of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat is limited to the foothills and eastern side in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Twenty-six of the corridors are in this region of the study area and capture most of the habitat patches.

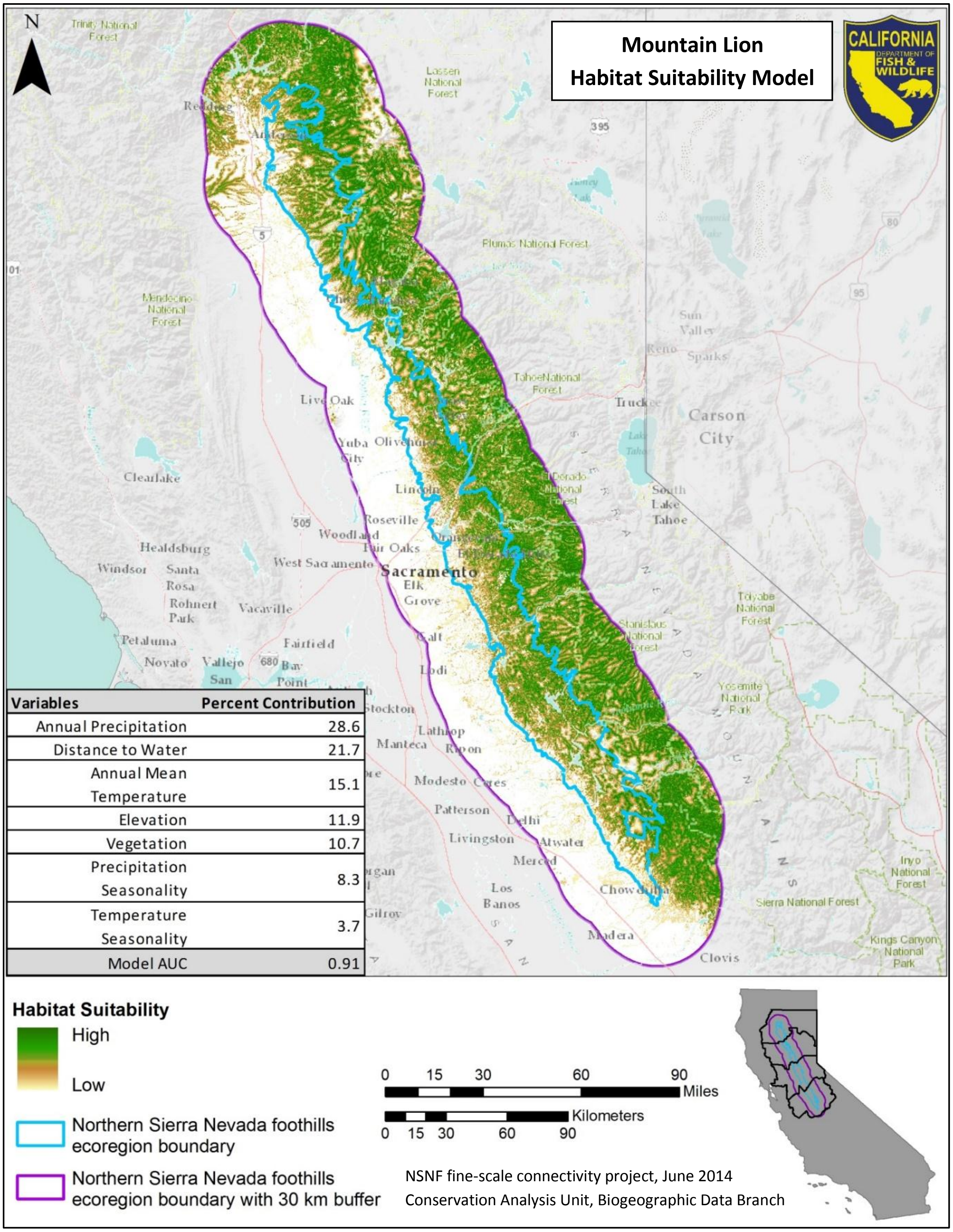
Region 4: Habitat is limited to eastern side in this region with only scattered patches in the foothills of the study area. Habitat patches on the eastern side of the study area are fairly continuous. Eleven of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.91	0.16	2,864,773.2	1,192,761.9	934

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
30.5	34.9	34.6

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
66	78.5	12.6	36.2	51.1

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
4.2	10.5	14.9	10.1



Variables	Percent Contribution
Annual Precipitation	28.6
Distance to Water	21.7
Annual Mean Temperature	15.1
Elevation	11.9
Vegetation	10.7
Precipitation Seasonality	8.3
Temperature Seasonality	3.7
Model AUC	0.91

Figure S-83. Predicted habitat suitability for the mountain lion (*Puma concolor*). Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer.

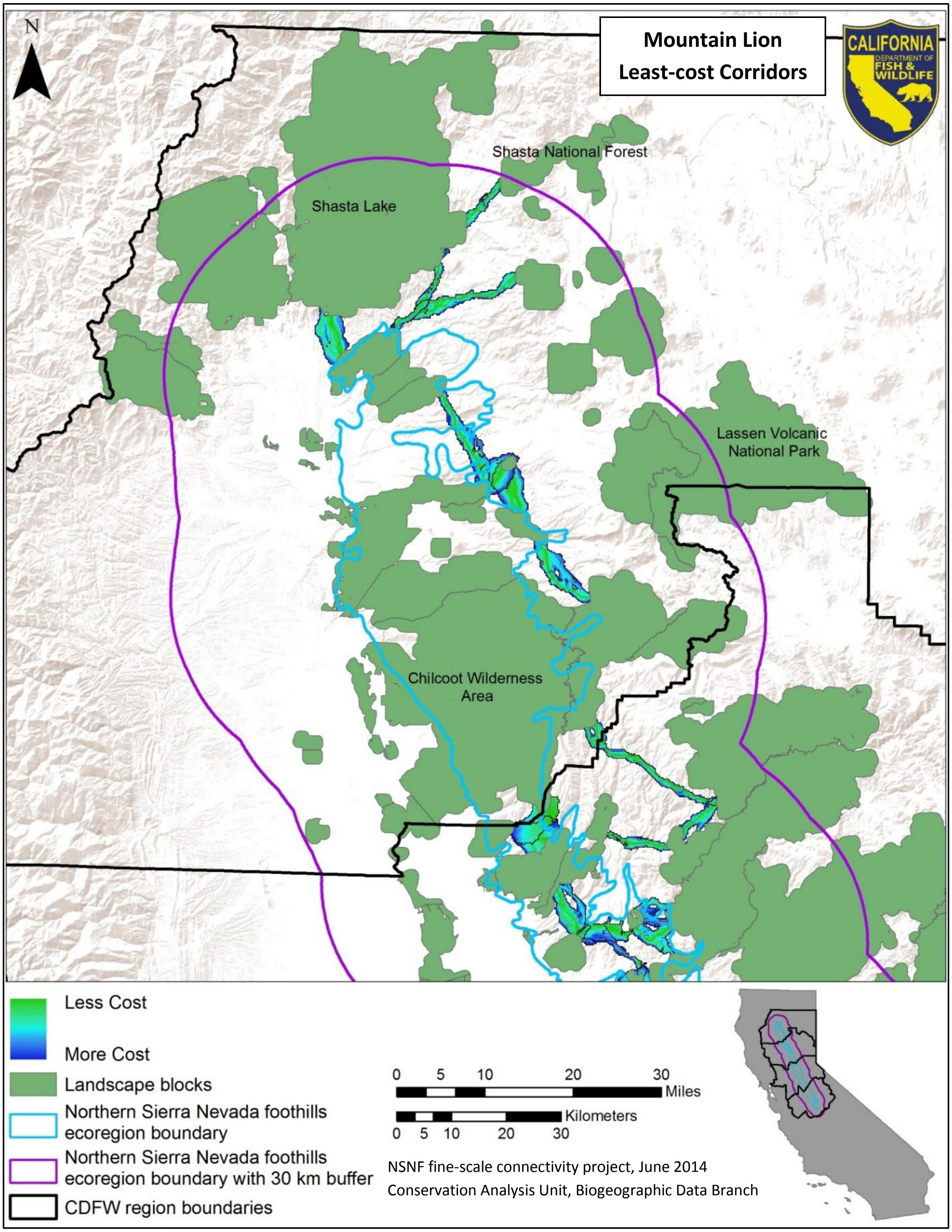


Figure S-84. Habitat patch analysis for the mountain lion (*Puma concolor*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >100,000 ha; breeding patches were contiguous areas of suitable habitat >20,000 ha.

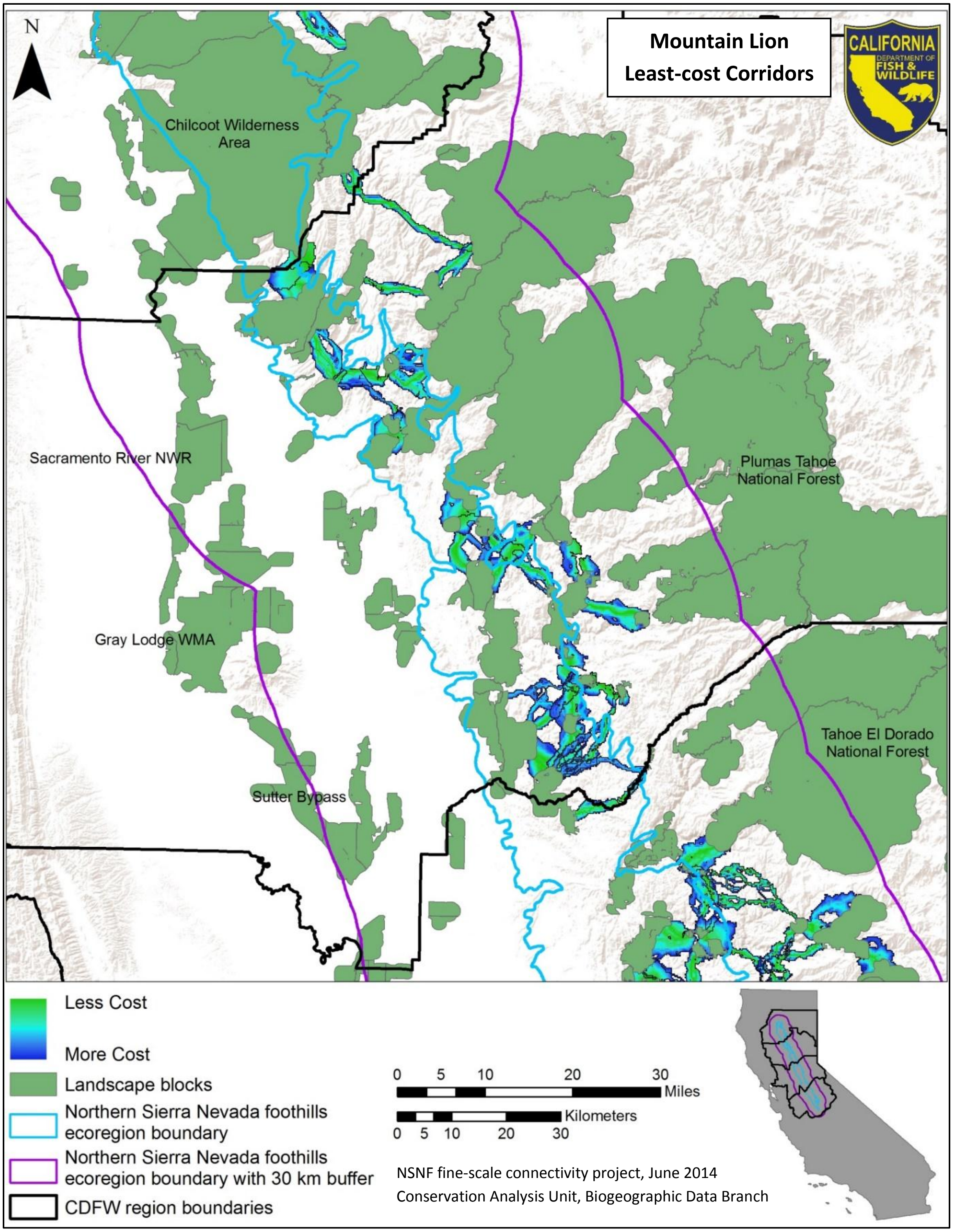


Figure S-85. Habitat patch analysis for the mountain lion (*Puma concolor*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >100,000 ha; breeding patches were contiguous areas of suitable habitat >20,000 ha.

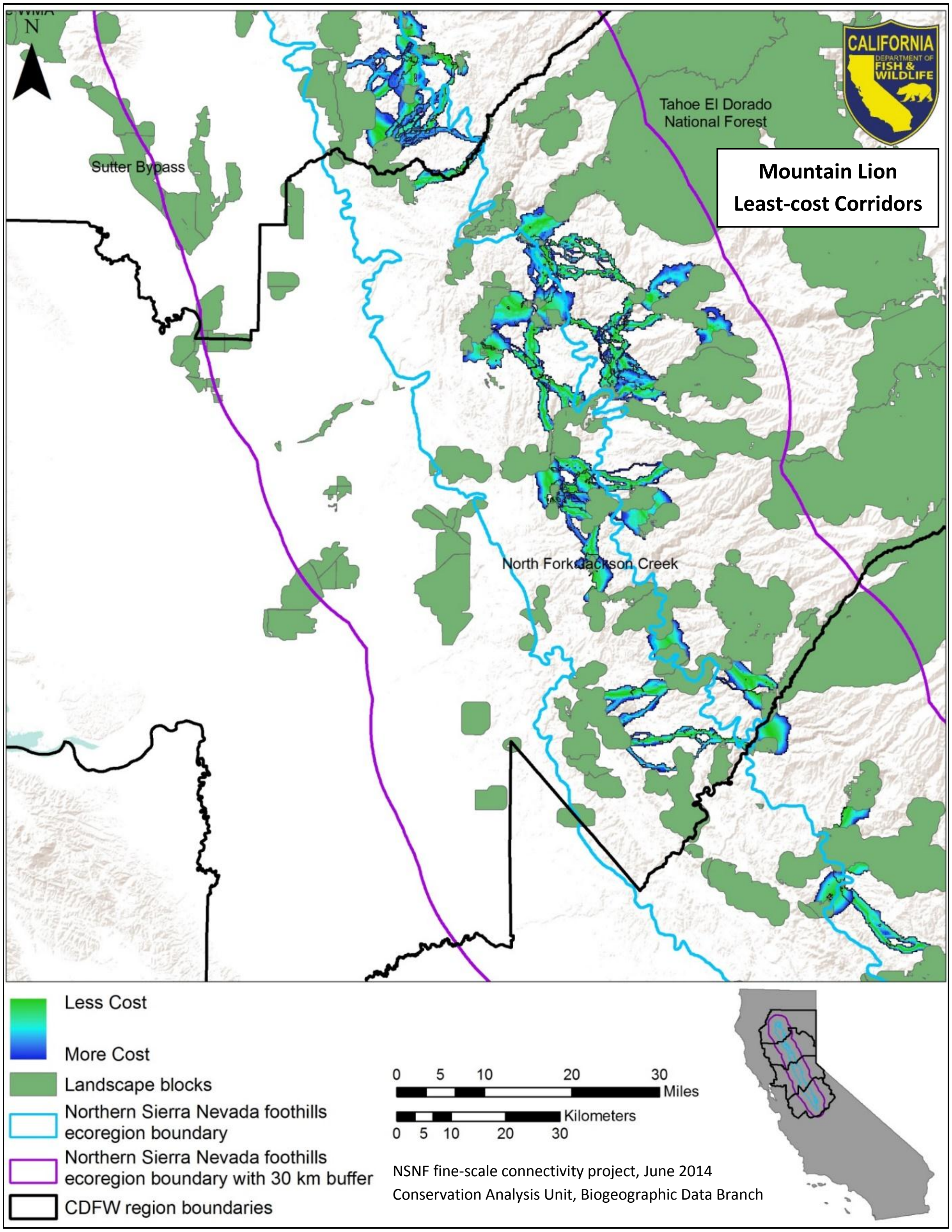


Figure S-86. Habitat patch analysis for the mountain lion (*Puma concolor*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >100,000 ha; breeding patches were contiguous areas of suitable habitat >20,000 ha.

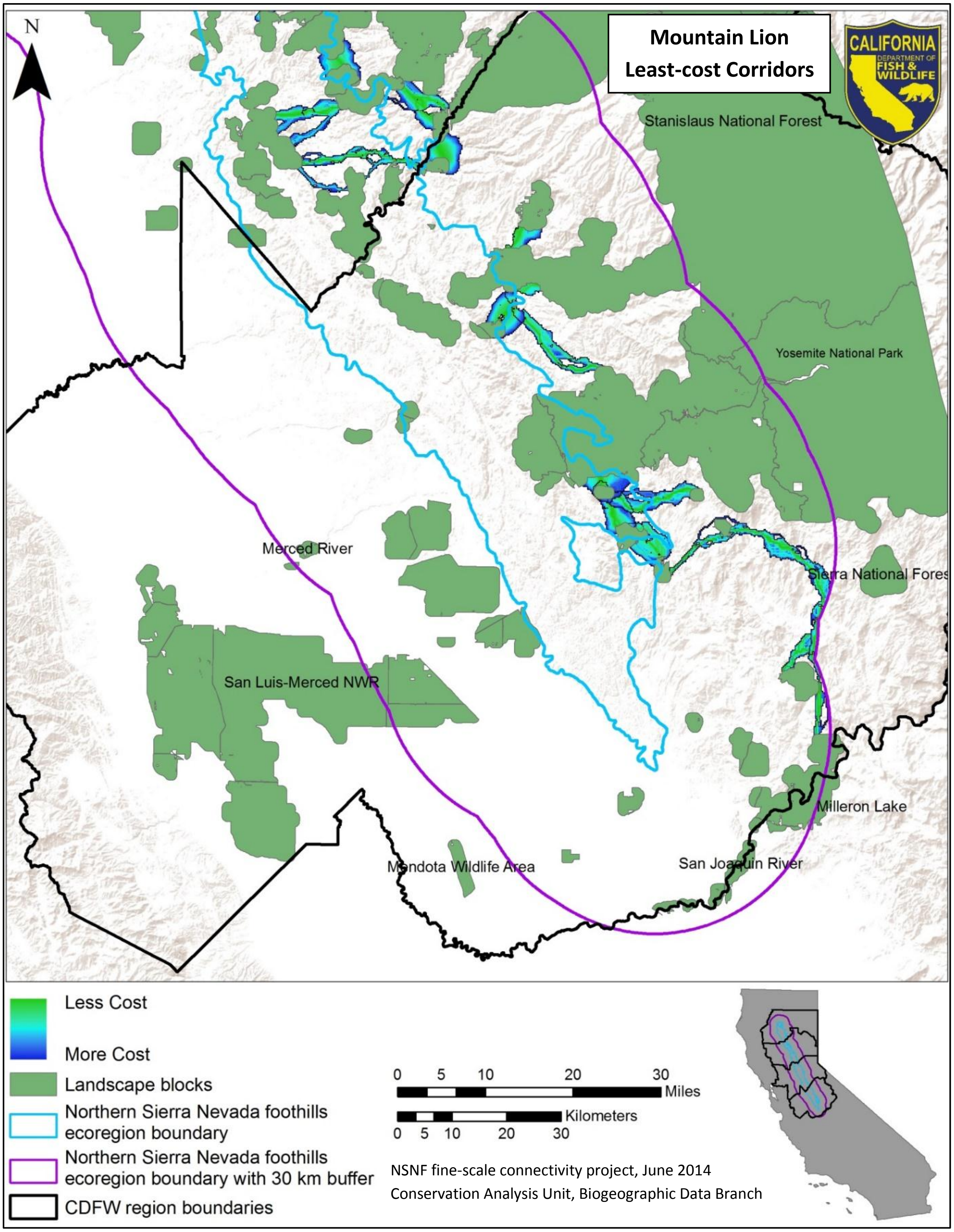


Figure S-87. Habitat patch analysis for the mountain lion (*Puma concolor*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >100,000 ha; breeding patches were contiguous areas of suitable habitat >20,000 ha.

Mountain quail (*Oreotyx pictus*)

Focal species selection: Mountain quail are common to uncommon residents, typically found in montane habitats (CWHR 2008). The species is found in open, brushy stands of conifer, deciduous forest, woodland, and chaparral (CWHR 2008). Mountain quail can meet its water needs from food and dew in cool weather, but in warm weather it requires drinking water and may gather at water sources (CWHR 2008). In summer, broods are seldom found more than 0.8 km from water (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the mountain quail was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for mountain quail were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 7245 location points to train each model, 1812 to test each model, and 9057 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Home range in Idaho averaged 2.6 km^2 a sedentary population (CWHR 2008). Broods remained in draws near water, often remaining with 0.8 to 1.2 ha for several days; few movements exceeded 0.8 km in summer (CWHR 2008). Minimum breeding patch size used was 4 ha; minimum population patch size was 500 ha.

Dispersal/Migration: The species may migrate upslope and downslope up to 32 km (CWHR 2008). Mountain quail generally travel along the ground, even when migrating. The species usually breeds at higher elevations and moves downslope for winter, following the snowline (CWHR 2008). Maximum dispersal distance used was 32 km.

Results and Discussion: The selected mountain quail habitat suitability model was Maxent scenario 7. The model performed well with an AUC of 0.78. The mean probability threshold was 0.23 predicting 1,616,980.3 ha of suitable habitat. The patch analysis identified 233 breeding patches covering 12,763.1 ha and 31 population patches covering 1,862,909.6 ha. One hundred fourteen of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 72% of the total corridor area. Mountain quail habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 39.6% of habitat area in the corridors had high predicted suitability, 38.3% medium and 22.1% low.

Potential habitat for mountain quail is widespread throughout eastern side of the study area and limited within the foothills.

Region 1: Most habitat patches are continuous on the eastern side of the northern region, with isolated patches on the western side near Whiskeytown-Shasta-Trinity NRA block. The linkages capture most of the habitat patches in the north and east between Chilcoot WA and Shasta Lake and Lassen Volcanic NP.

Region 2 North: Habitat is limited to the eastern side in this region with only scattered patches in the foothills. Habitat patches in the foothills are within the dispersal distance of the species and are captured by the linkages. Habitat patches on the eastern side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the eastern side in this region with only scattered patches in the foothills. Habitat patches in the foothills are within the species' dispersal distance and are captured by the linkages. Habitat patches on the eastern side of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat is limited to the eastern side in this region of the study area. Habitat patches on the eastern side of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.78	0.23	1,616,980.3	1,876,673.1	264

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
14.9	31.9	53.1

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
114	72.0	22.1	38.3	39.6

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
43.4	35.2	21.9	29.3

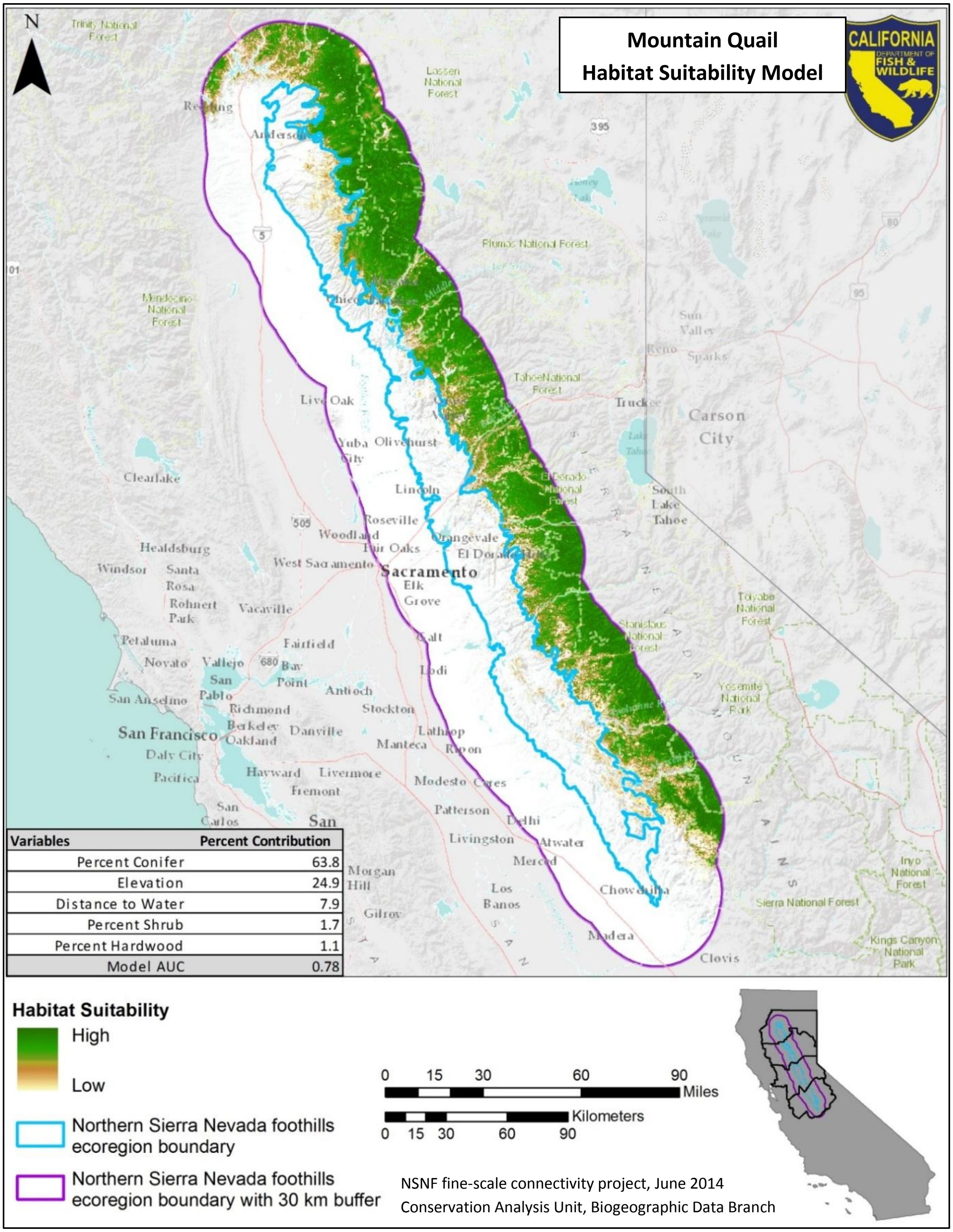


Figure S-88. Predicted habitat suitability for the mountain quail (*Oreotyx pictus*). Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub).

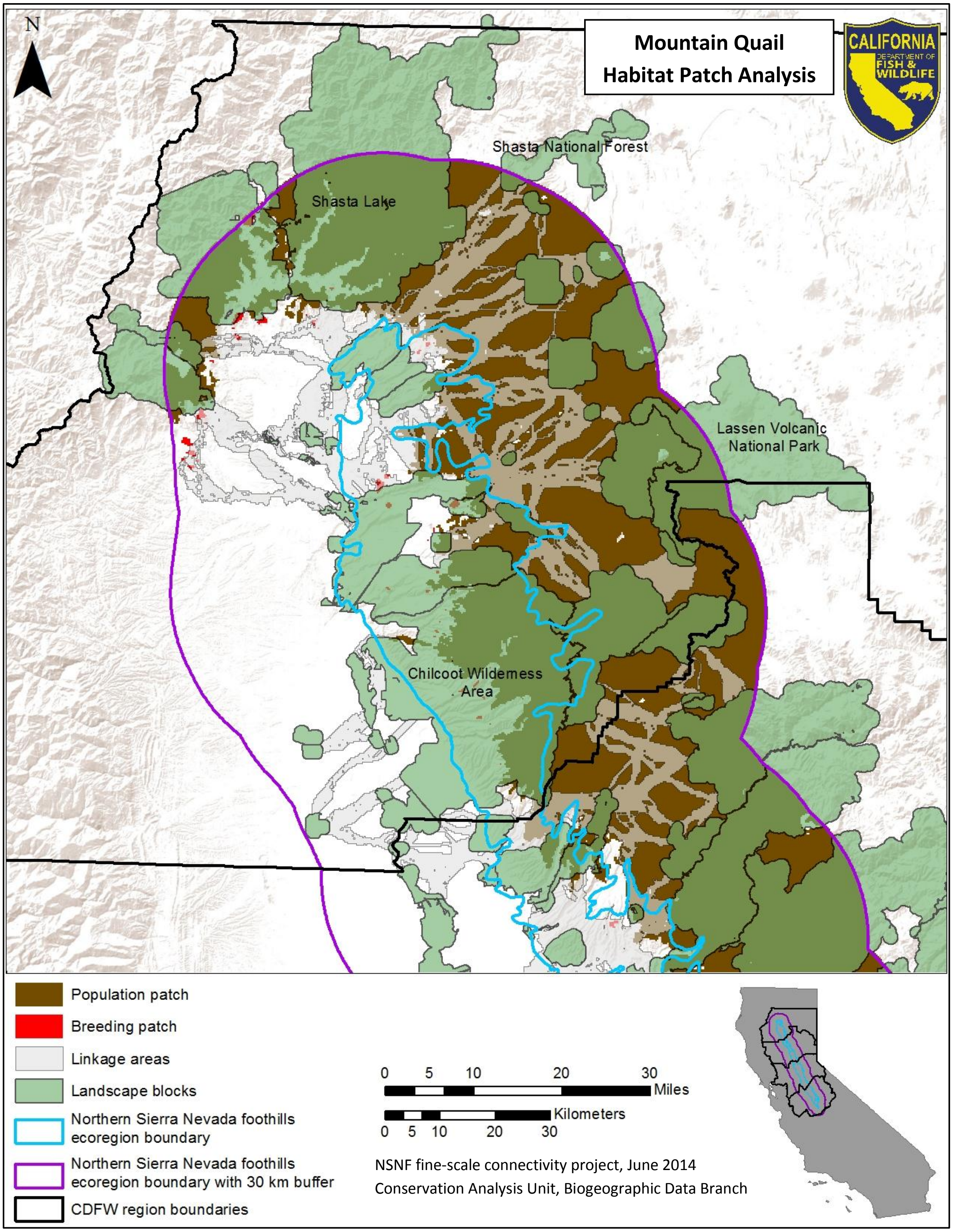


Figure S-89. Habitat patch analysis for the mountain quail (*Oreotyx pictus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

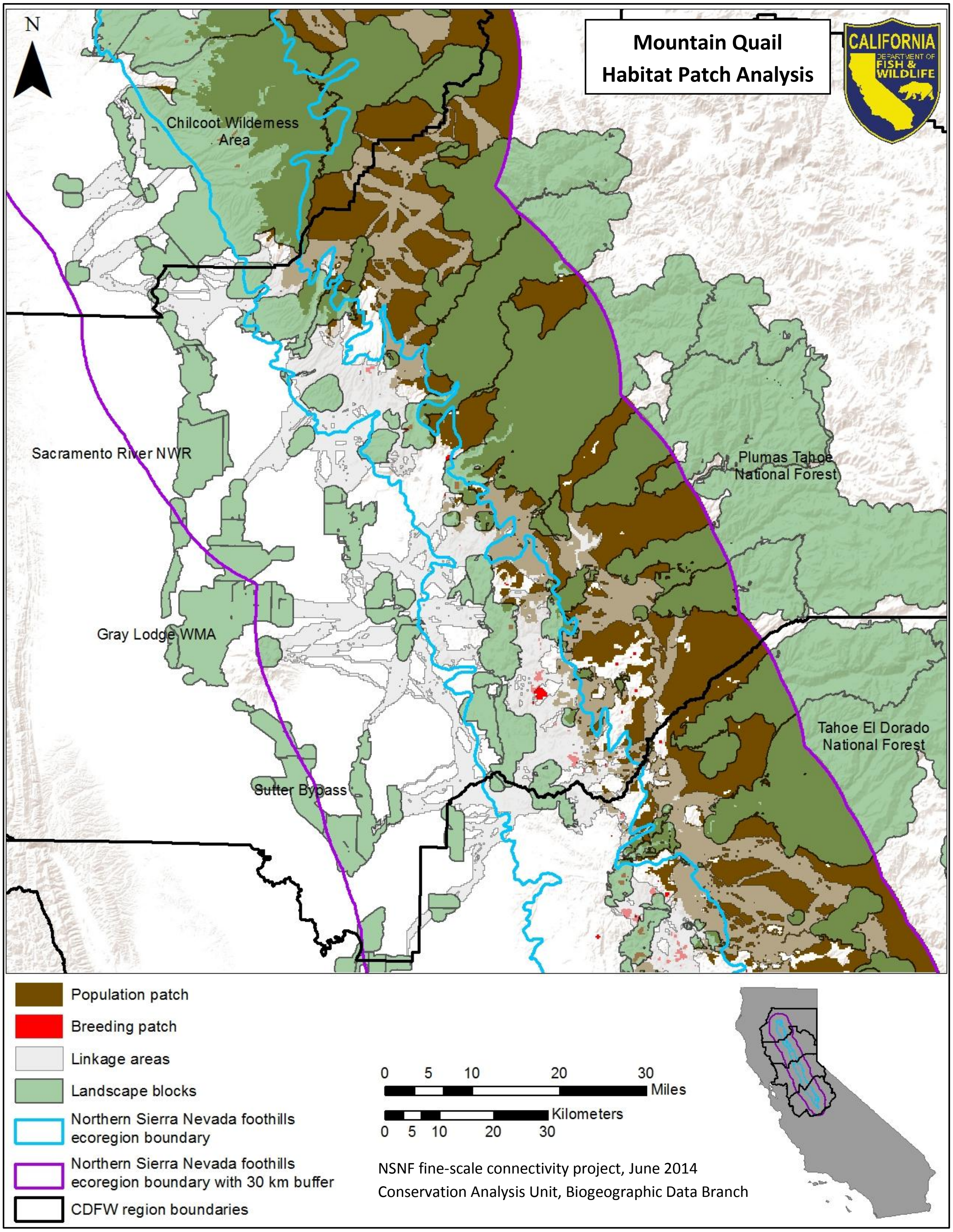


Figure S-90. Habitat patch analysis for the mountain quail (*Oreotyx pictus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

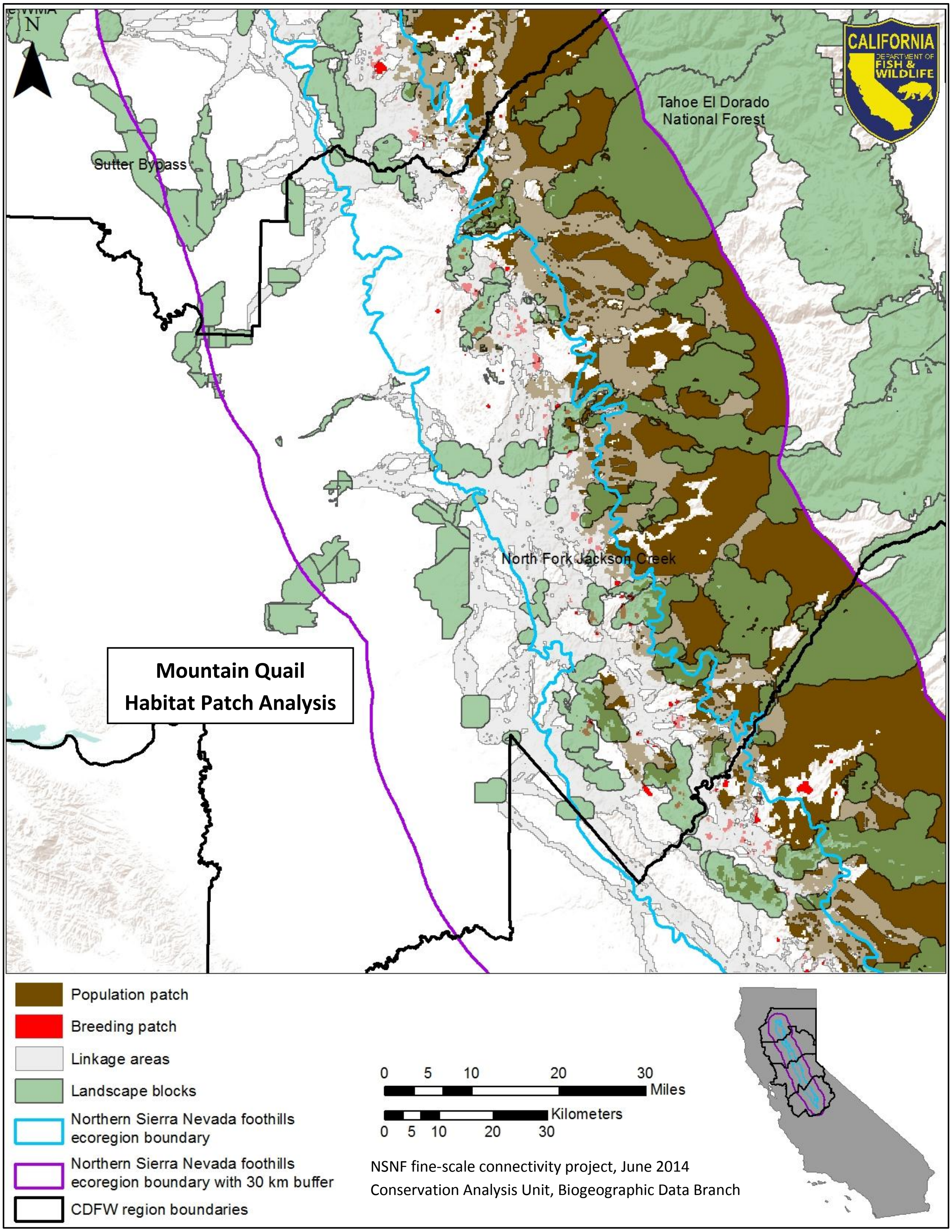


Figure S-91. Habitat patch analysis for the mountain quail (*Oreotyx pictus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

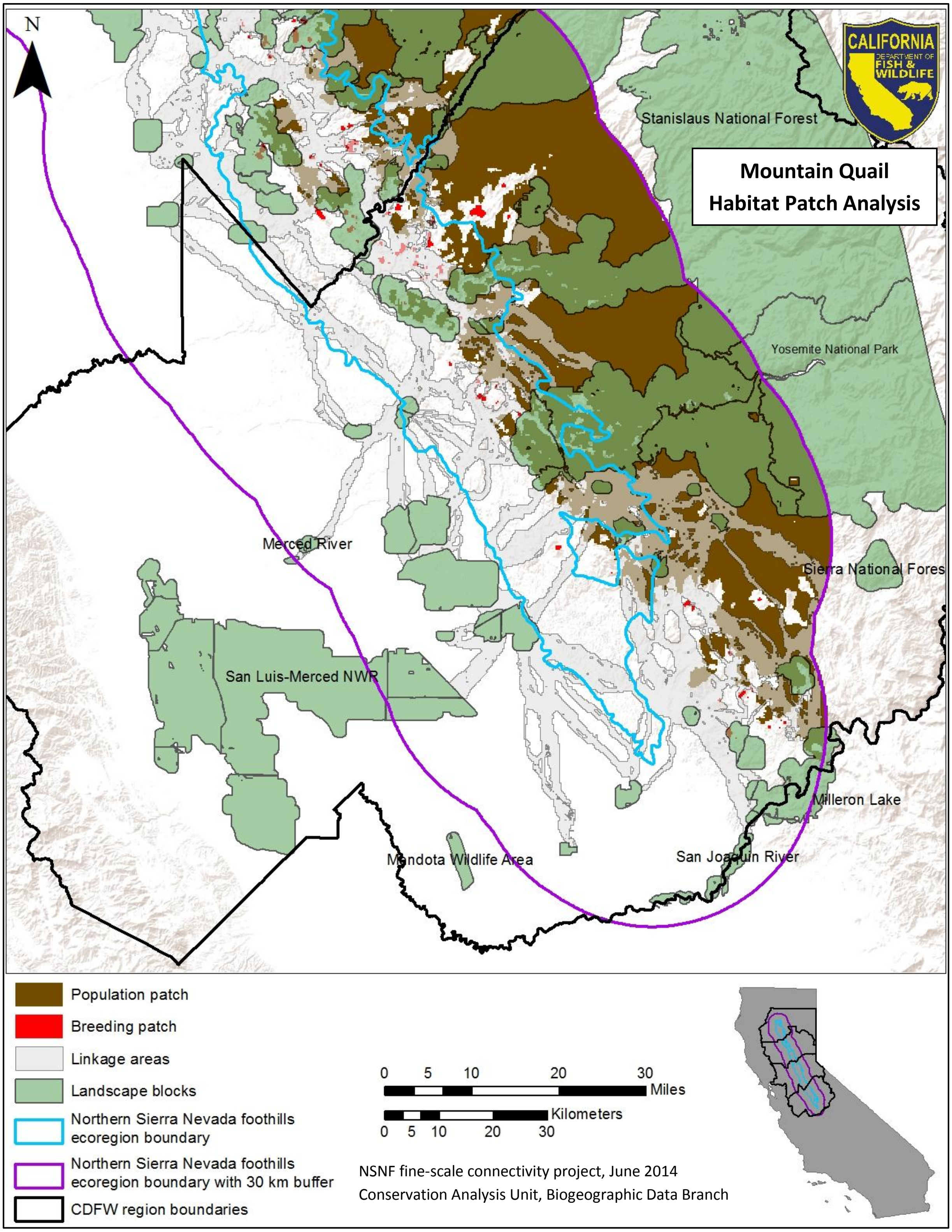


Figure S-92. Habitat patch analysis for the mountain quail (*Oreotyx pictus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >4 ha.

Mule deer (*Odocoileus hemionus*)

Focal species selection: Mule deer are common yearlong resident or elevational migrants with a widespread distribution throughout most of California (CWHR 2008). Mule deer occur in early to intermediate successional stages of most forest, woodland and brush habitats, as well as along major river corridors in the Central Valley and in scattered desert mountain areas. Mule deer prefer a mosaic of various-aged vegetation that provides woody cover, meadow and shrubby openings and free water. Deer drink water every day (CWHR 2008). Mule deer are **barrier sensitive**, and the impact of vehicle collisions with deer is a concern both for deer populations and for human safety (Romin and Bissonette 1996).

Habitat Model: The final three habitat suitability models developed for mule deer were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 446 location points to train each model, 112 to test each model, and 9860 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Typical home ranges of small doe and fawn groups were 1-3 km^2 but varied from 0.5 to 5 km^2 in Lake County (Taber and Dasmann 1958). Bucks usually have larger home ranges and travel longer distances than doe and fawn groups (Brown 1961). Minimum breeding patch size used was 100 ha; minimum population patch size was 500 ha.

Dispersal/Migration: Mule deer in California may be resident or migratory. In the mountains, mule deer migrate downslope in winter to areas having less than 46 cm of snow (CWHR 2008). As the snow melts they migrate to higher elevations to their summer range (CWHR 2008). Maximum dispersal distance used was 217 km.

Results and Discussion: The selected mule deer habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.75. The mean probability threshold was 0.34, predicting 3,529,387.9 ha of suitable habitat. The patch analysis identified 105 breeding patches covering 19,769.79 ha and 90 population patches covering 2,997,179.0 ha. We identified 134 mule deer least-cost corridors. Habitat patches covered 88% of the total corridor area. The corridors were throughout study area and ranged in elevation from 10 m to 2,068 m. The least-cost corridors covered 645,855.6 ha of land, of those 10.5% were designated as GAP 1, 2 or 3 lands or in conservation easements, 89.5% are private lands. Mule deer corridors covered many different vegetation types: 28% of total mule deer corridor area was in grassland, 27% in oak woodland, 11% hardwood and 9% in row or field crop. Mule deer habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 23.4% of habitat area in the corridors had high predicted suitability, 71.7% medium and 5% low.

Potential habitat for the mule deer is widespread throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region. Twenty-one of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat is scattered in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Forty-two of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat patches on the western side near the Cosumnes River Ecological Reserve block are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Fifty-two of the corridors are in this region of the study area and capture most of the habitat patches.

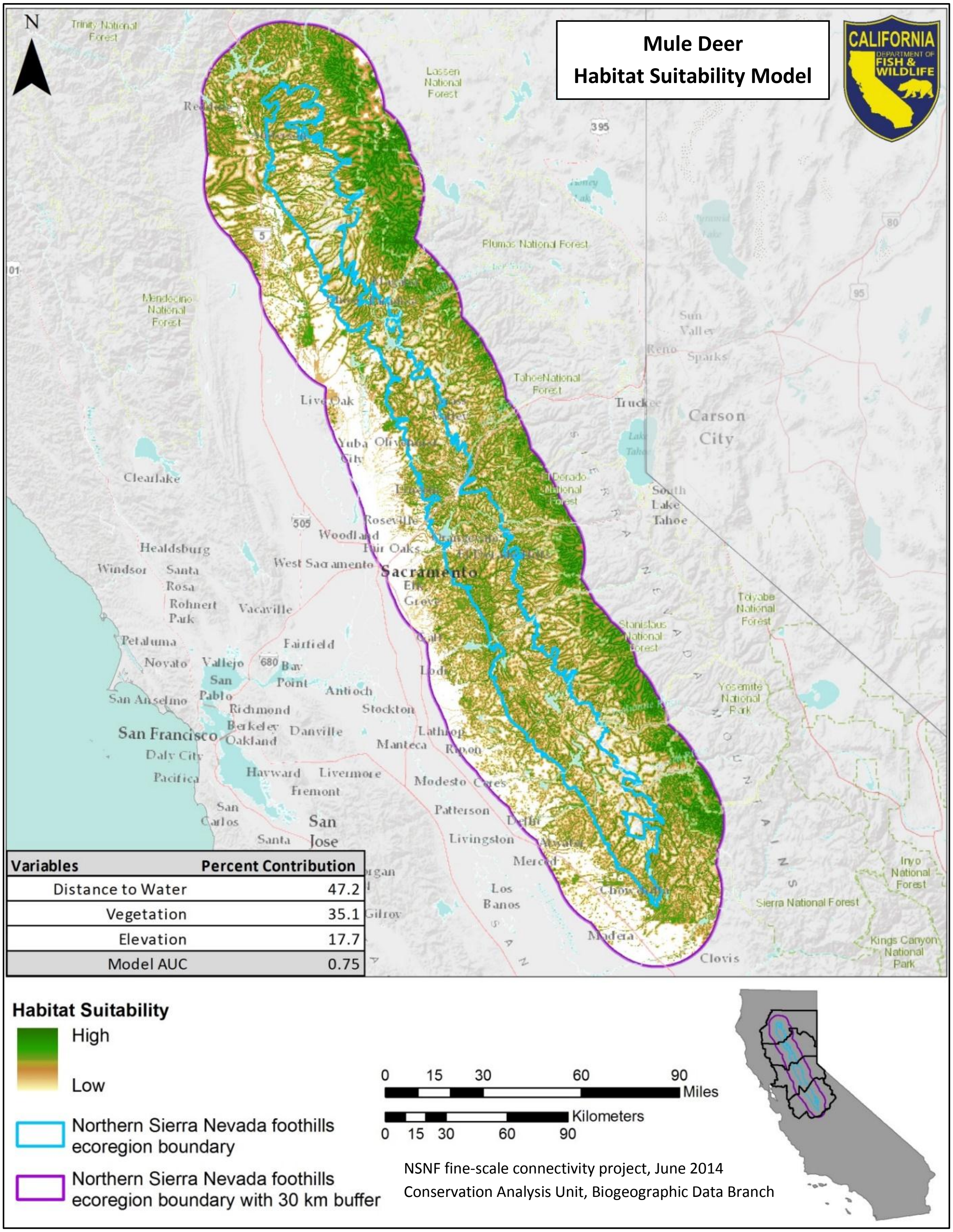
Region 4: Habitat is scattered patches throughout this region of the study area Habitat patches are fairly continuous. Thirty-four of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.75	0.34	3,529,387.9	3,028,627.3	626

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
9.1	71.8	19.2

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
134	88.0	5.0	71.7	2.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
9.4	17.1	20.9	17.1



Variables	Percent Contribution
Distance to Water	47.2
Vegetation	35.1
Elevation	17.7
Model AUC	0.75

Figure S-93. Predicted habitat suitability for the mule deer (*Odocoileus hemionus*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

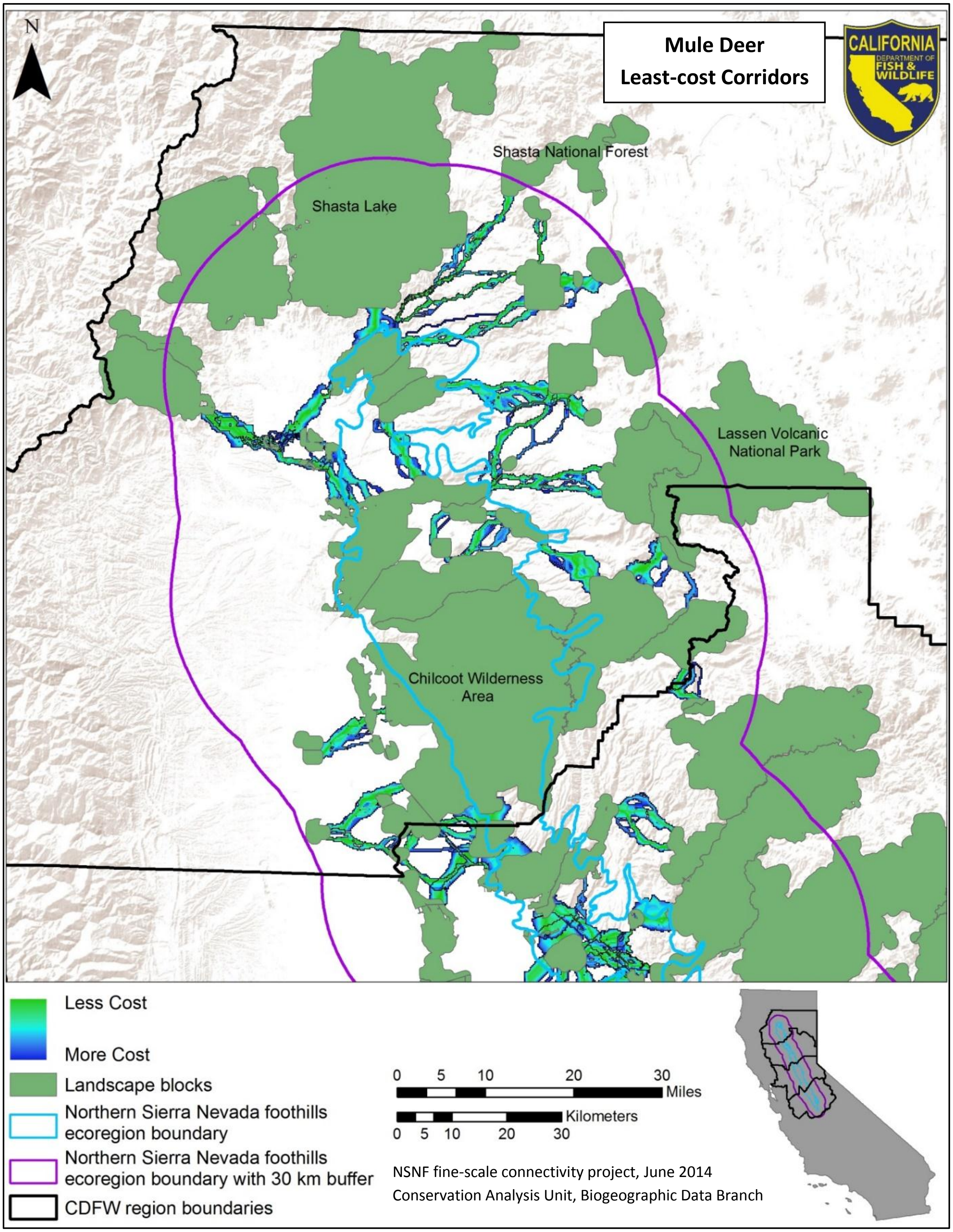


Figure S-94. Habitat patch analysis for the mule deer (*Odocoileus hemionus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >100 ha.

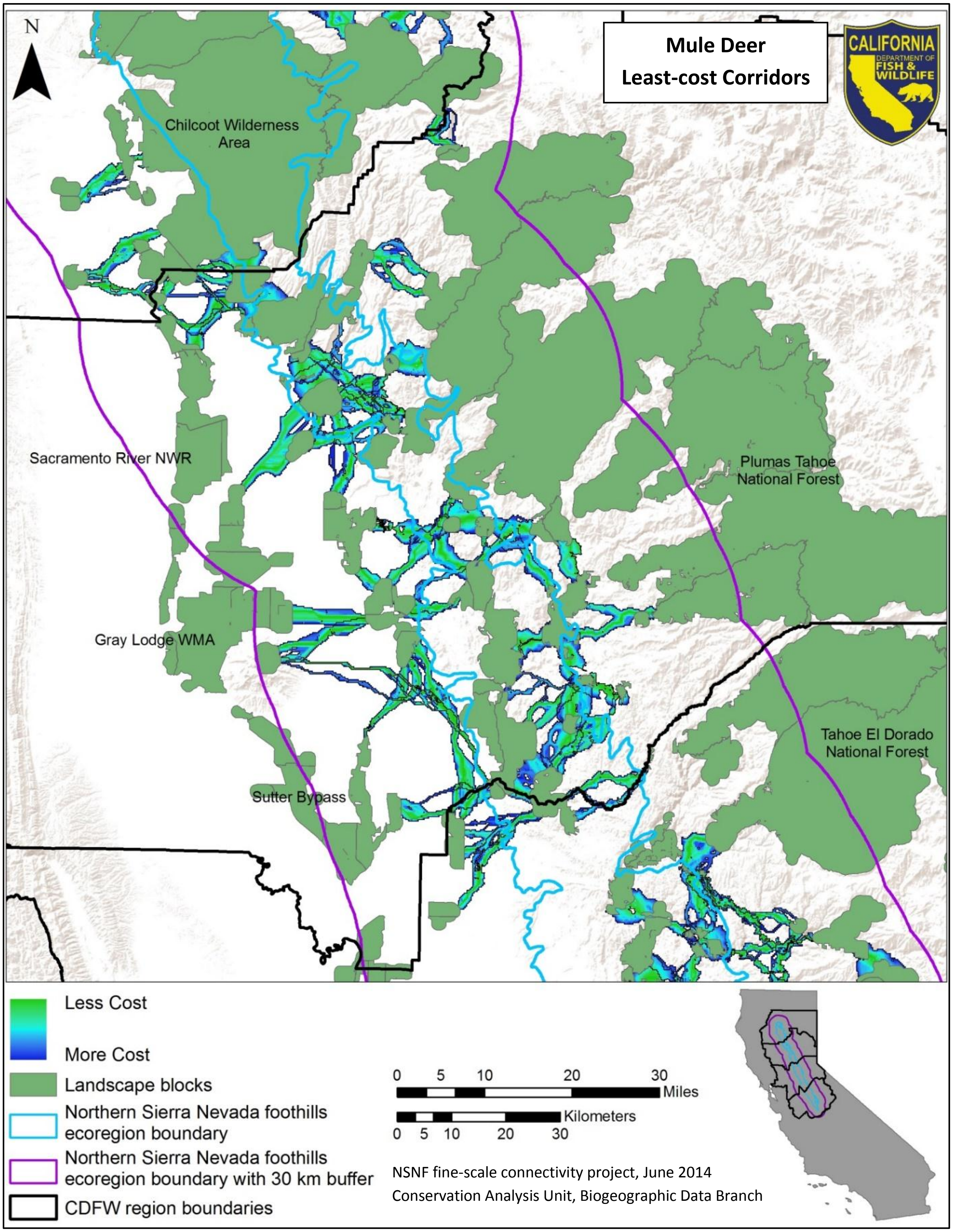


Figure S-95. Habitat patch analysis for the mule deer (*Odocoileus hemionus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >100 ha.

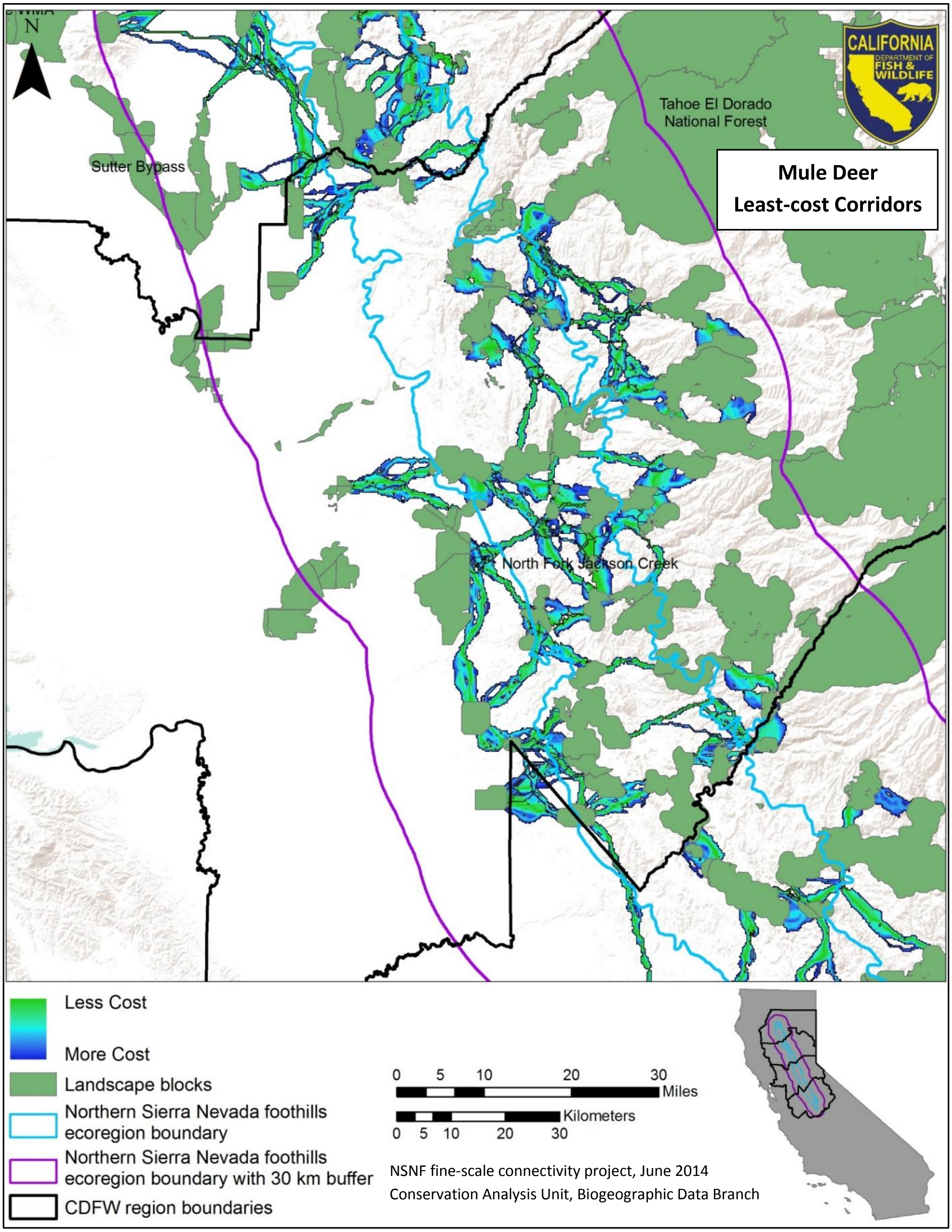


Figure S-96. Habitat patch analysis for the mule deer (*Odocoileus hemionus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >100 ha.

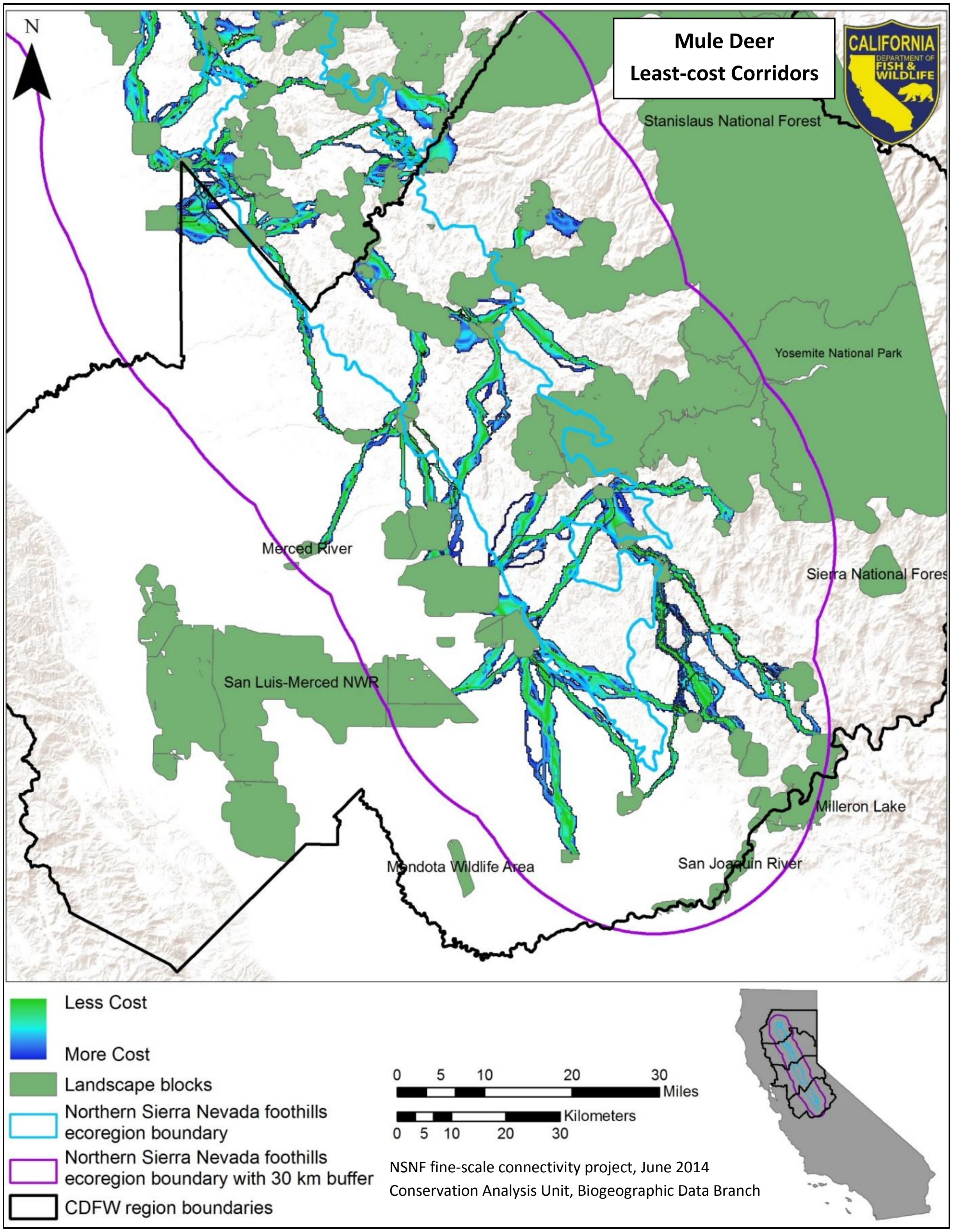


Figure S-97. Habitat patch analysis for the mule deer (*Odocoileus hemionus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >500 ha; breeding patches were contiguous areas of suitable habitat >100 ha.

Northern pygmy owl (*Glaucidium gnoma*)

Focal species selection: Northern pygmy owls are uncommon to fairly common yearlong residents of most forest habitats in California, especially in valley foothill hardwood, mixed conifer, valley foothill riparian and montane riparian (CWHR 2008). The species is most commonly found along edges near meadows, streams, lakes, and other openings (CWHR 2008). This owl is distributed from sea level to 3600 m the length of the state, excluding the Modoc Plateau, Central Valley and treeless desert areas, and is usually scarce above 1800 m (CWHR 2008). No information on water needs was found. Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the northern pygmy owl was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for northern pygmy owl were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 1075 location points to train each model, 269 to test each model, and 9714 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Little information is known on home range. In the Rocky Mountains of Montana and Idaho, the areas used by family groups during the post-fledging dependency period range from 34.6 to 94.5 ha (Frye and Jageman 2012). Minimum breeding patch size used was 150 ha; minimum population patch size was 1,500 ha.

Dispersal/Migration: The species is non migratory, but may move upslope or downslope in response to weather conditions. Maximum dispersal distance 3.34 used was km (Frye and Jageman 2012).

Results and Discussion: The selected northern pygmy-owl habitat suitability model was Maxent scenario 7. The model performed well with an AUC of 0.88. The mean probability threshold was 0.21 predicting 2,821,711.1 ha of suitable habitat. The patch analysis identified 279 breeding patches covering 85,385.5 ha and 152 population patches covering 1,514,659.9 ha. One hundred sixty-two of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 52.8% of the total corridor area. Northern pygmy-owl habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 9.7% of habitat area in the corridors had high predicted suitability, 50.8% medium and 39.5% low.

Potential habitat for the Northern pygmy owl is widespread throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with isolated patches on the western side of the Chilcoot Wilderness Area. The linkages capture most of the habitat patches in foothills and eastern side of the study area.

Region 2 North: Habitat is limited to the eastern side in this region with only scattered patches in the foothills of the study area. Habitat patches within the foothills are within the Northern pygmy owls dispersal distance and are captured by the linkages. Habitat patches in the eastern side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Consumnes River Ecological Reserve block are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills are within the Northern pygmy owls dispersal distance and are captured by the linkages. Habitat patches on the eastern side of the study area are fairly continuous and are captured by most linkages.

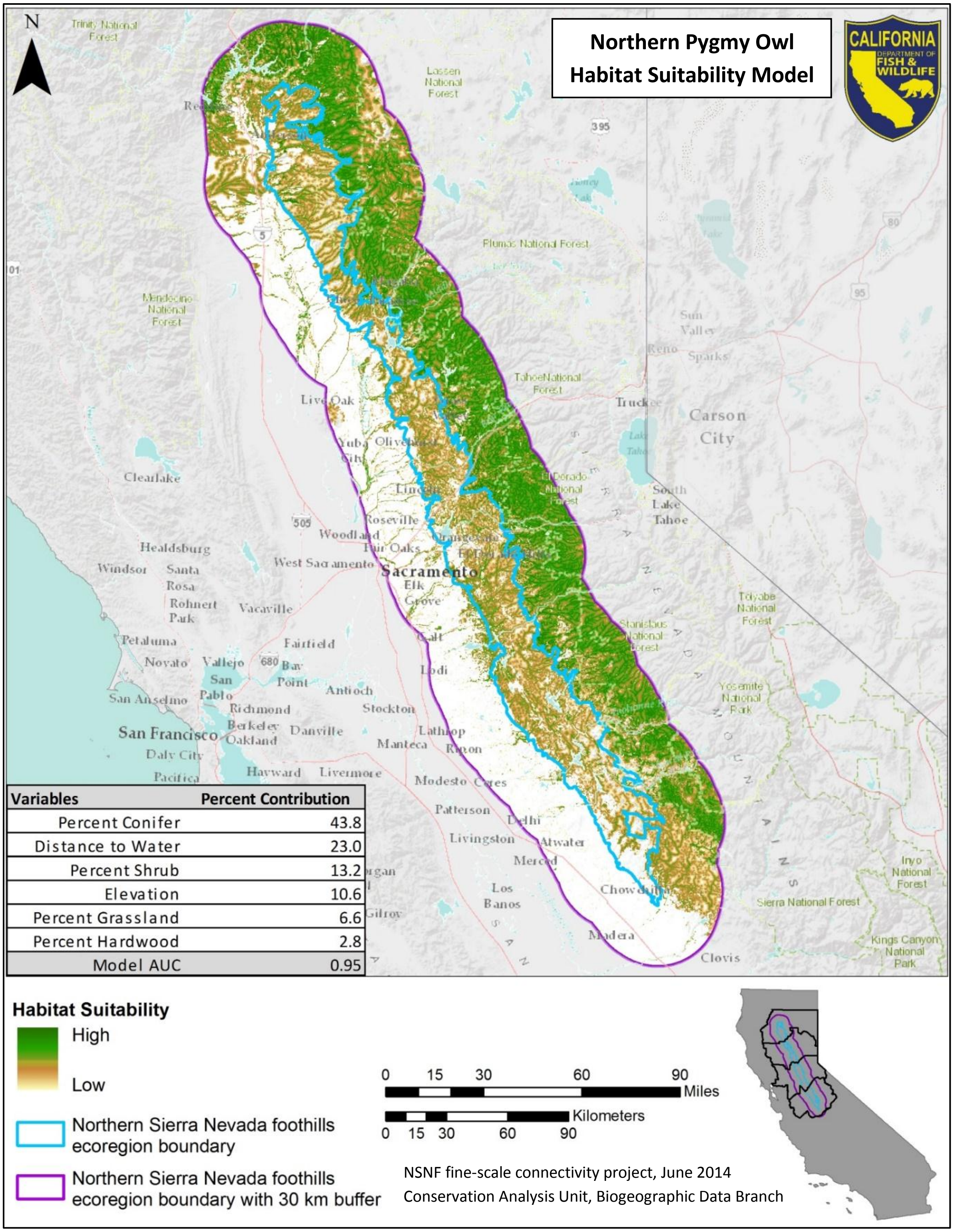
Region 4: Habitat is limited to the eastern side in this region with only scattered patches in the foothills of the study area. Habitat patches in the foothills and eastern side of the study area are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.88	0.21	2,821,711.1	1,637,675.5	1,594

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
37.7	51.3	10.9

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
162	52.8	39.5	50.8	9.7

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
43.8	41.4	37.2	41.9



Variables	Percent Contribution
Percent Conifer	43.8
Distance to Water	23.0
Percent Shrub	13.2
Elevation	10.6
Percent Grassland	6.6
Percent Hardwood	2.8
Model AUC	0.95

Figure S-98. Predicted habitat suitability for the northern pygmy owl (*Glaucidium gnoma*). Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub).

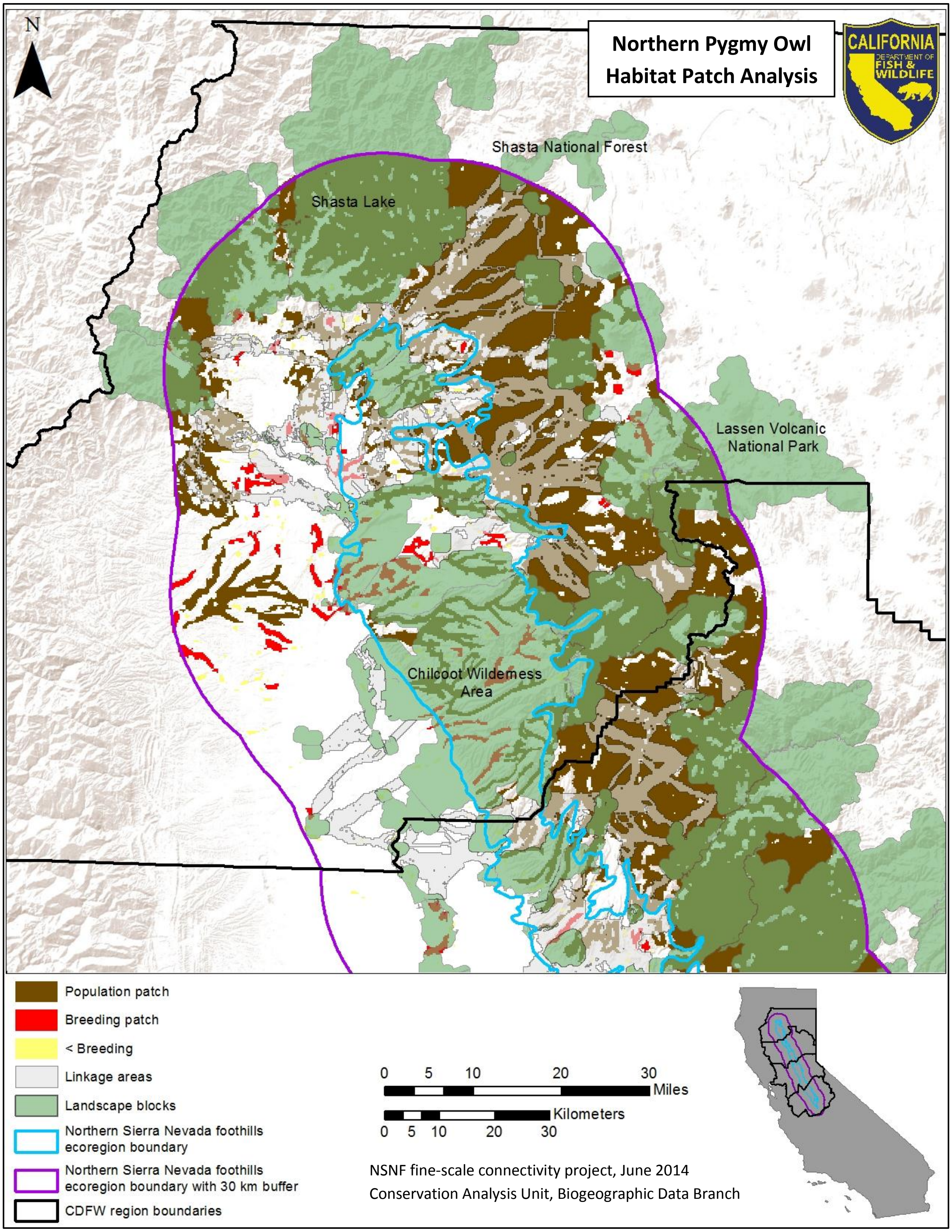


Figure S-99. Habitat patch analysis for the northern pygmy owl (*Glaucidium gnoma*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >1,500 ha; breeding patches were contiguous areas of suitable habitat >150 ha.

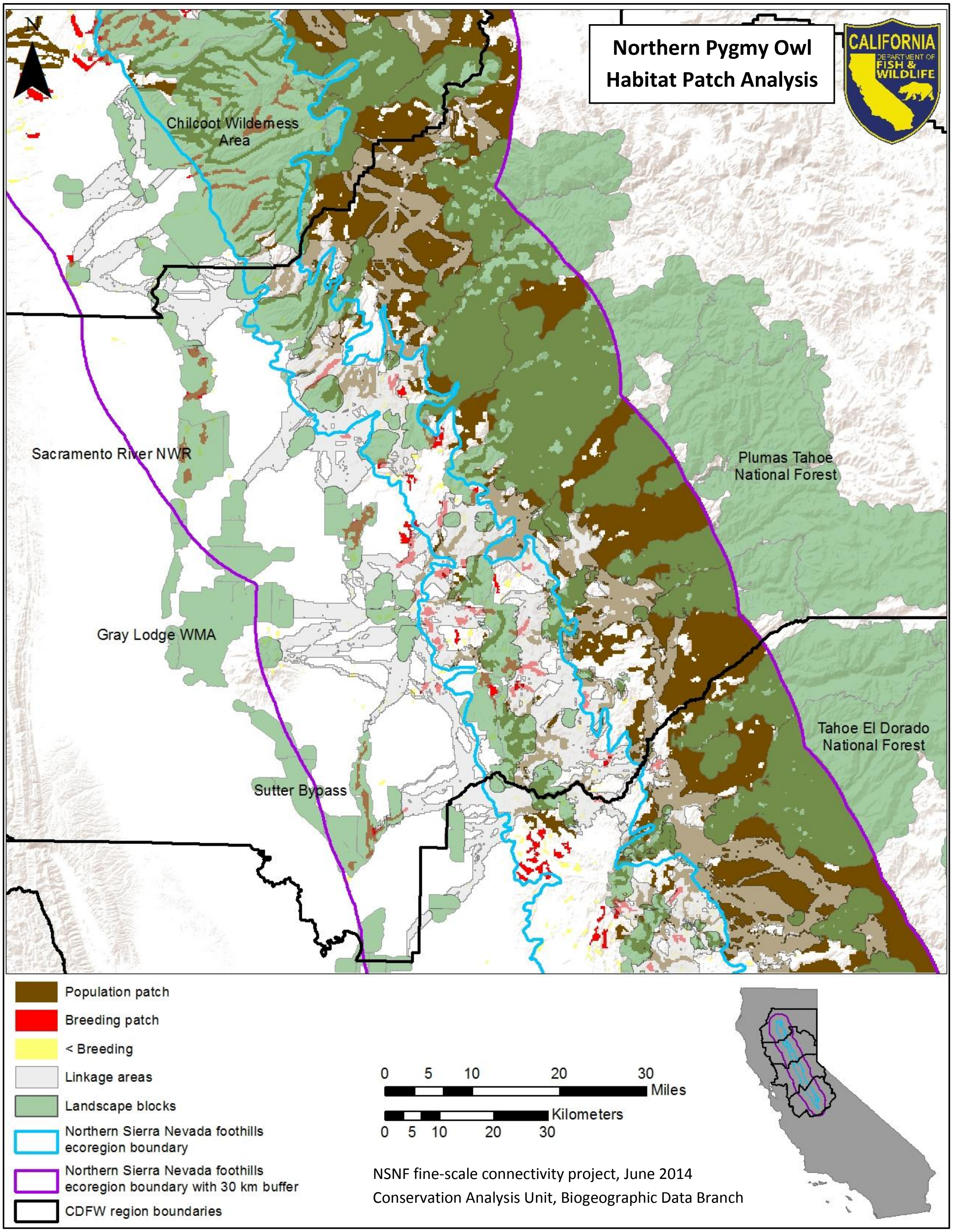


Figure S-100. Habitat patch analysis for the northern pygmy owl (*Glaucidium gnoma*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >1,500 ha; breeding patches were contiguous areas of suitable habitat >150 ha.

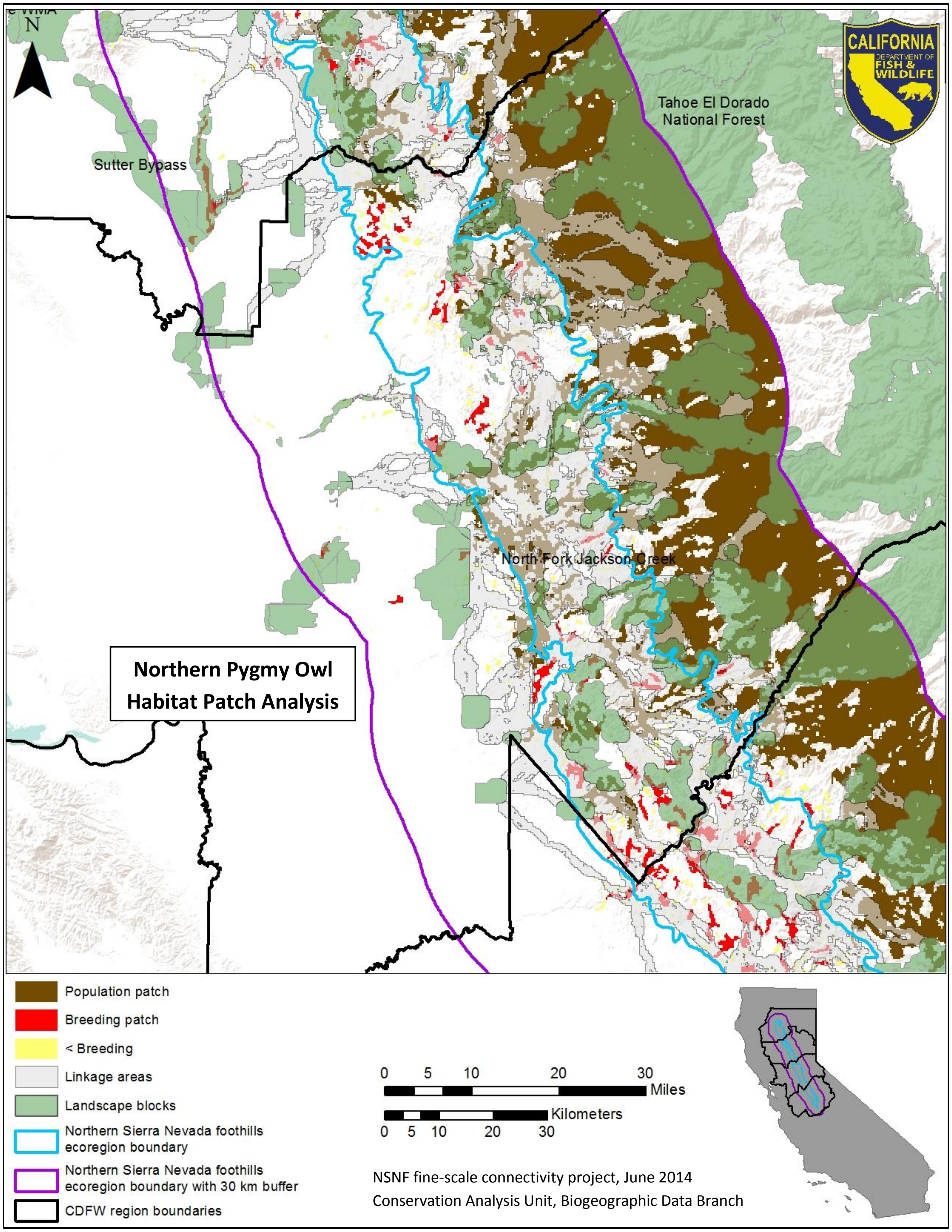


Figure S-101. Habitat patch analysis for the northern pygmy owl (*Glaucidium gnoma*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >1,500 ha; breeding patches were contiguous areas of suitable habitat >150 ha.

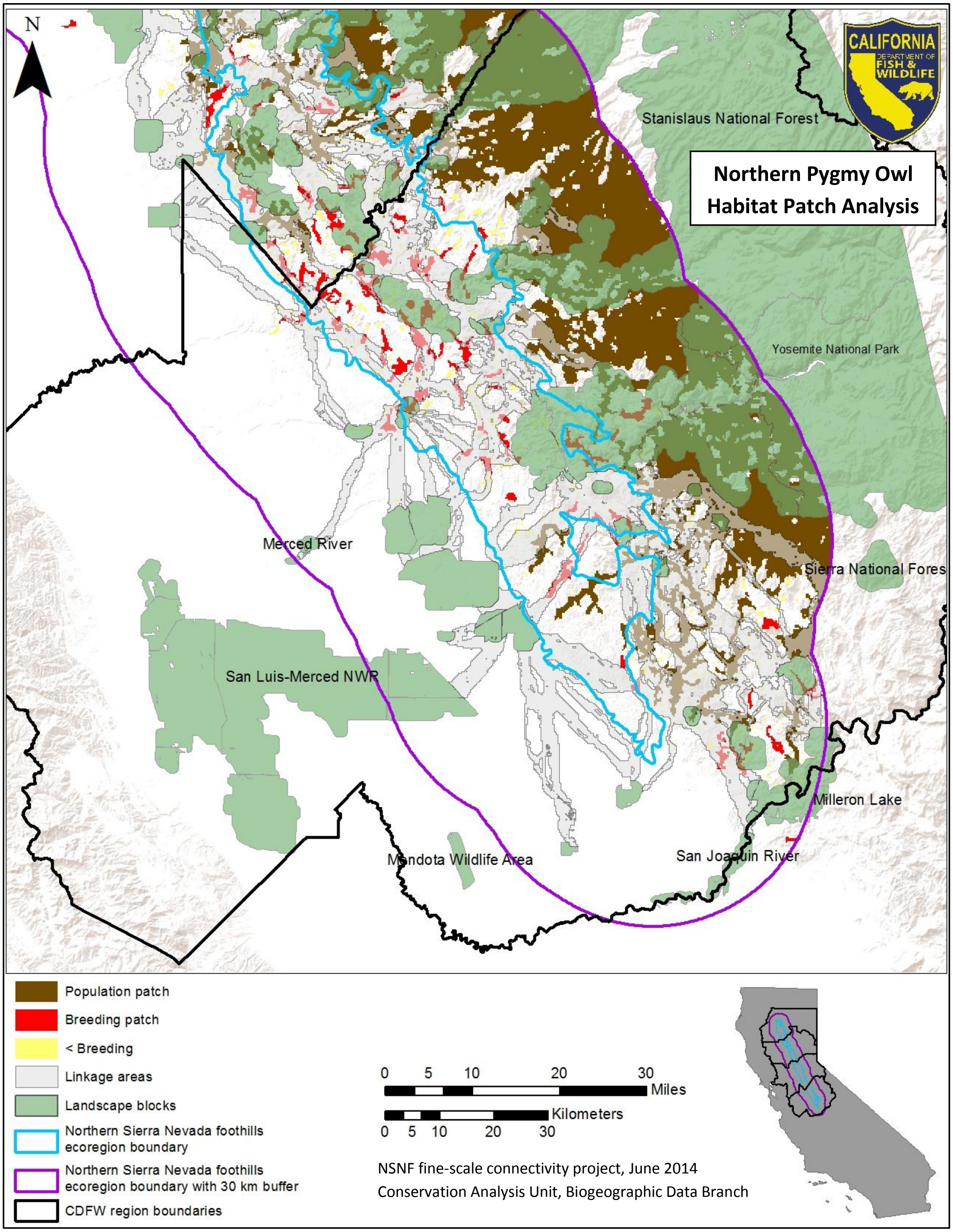


Figure S-102. Habitat patch analysis for the northern pygmy owl (*Glaucidium gnoma*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >1,500 ha; breeding patches were contiguous areas of suitable habitat >150 ha.

Pallid bat (*Antrozous pallidus*)

Focal species selection: The pallid bat is locally common at low elevations in California. It occurs throughout California except for the high Sierra Nevada and the northwestern corner of the state. The pallid bat occupies a variety of habitats, including grasslands, shrublands, woodlands and forests from sea level up through mixed conifer forests (CWHR 2008). The species is most common in open, dry habitats with rocky areas for roosting (CWHR 2008). The pallid bat needs water, but has a good urine-concentrating ability (Geluso 1978). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bat species. Therefore the pallid bat was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for pallid bat were the expert opinion CWHR Bioview, and Maxent scenarios 7m and 9m. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 336 location points to train each model, 84 to test each model, and 9821 background points. Environmental variables for the Maxent scenario 7m model included elevation, distance to water, distance to mines (roosting areas), and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9m model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, distance to mines (roosting areas), and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range**:** The species forages 0.5-2.5 km from day roost (CWHR 2008). Minimum breeding patch size used was 135 ha; minimum population patch size was 8,625 ha.

Dispersal/Migration: The pallid bat is non-migratory, but makes local movements to hibernation sites (CWHR 2008). Maximum dispersal distance used was 8.5 km.

Results and Discussion: The selected pallid bat habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.56.The model predicted 4,348,900.5 ha of suitable habitat. The patch analysis identified 314 breeding patches covering 155,849.2 ha and 58 population patches covering 2,494,063.8 ha. Two hundred six of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 85.2% of the total corridor area. Pallid bat habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 35.7% of habitat area in the corridors had high predicted suitability, 21.9% medium and 42.4% low.

Potential habitat for pallid bat is widespread throughout the foothills of the study area.

Region 1: Most habitat patches are continuous throughout the northern region and are captured by most linkages.

Region 2 North: Habitat is limited to the foothills and eastern side in this region in the national forest landscape blocks. Habitat patches on the western side near the Sacramento River NWR are isolated from the Chico block. Habitat patches in the foothills and eastern side of the study area are within the pallid bats dispersal distance and are captured by most linkages.

Region 2 South: Habitat patches are scattered in this region of the study area. Habitat patches on the western side near the Cosumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills are fairly continuous and are captured by most linkages. Habitat patches on the eastern side of the region that are captured within the landscape blocks may become more isolated from the foothills if the few connections are lost.

Region 4: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Merced River block are isolated from foothill blocks of Black Rascal Creek and San Luis NWR. The habitat patches near San Luis NWR are also isolated from the main foothill patches. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.56	n/a	4,348,900.5	2,689,146.9	1,359

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
67.9	16.1	15.9

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
206	85.2	42.4	21.9	35.7

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
21.9	47.7	79.0	35.2

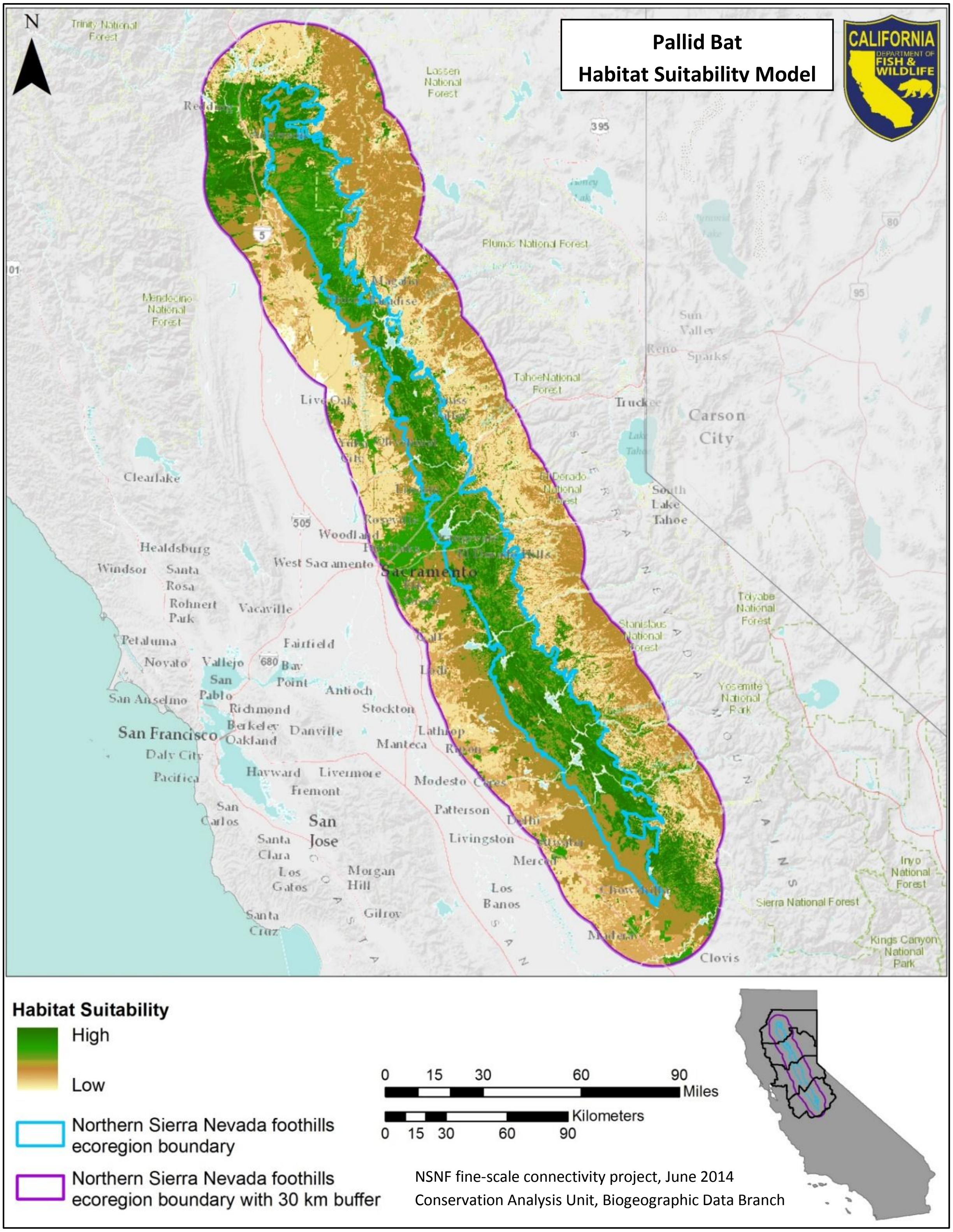


Figure S-103. Predicted habitat suitability for the pallid bat (*Antrozous pallidus*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes**.**

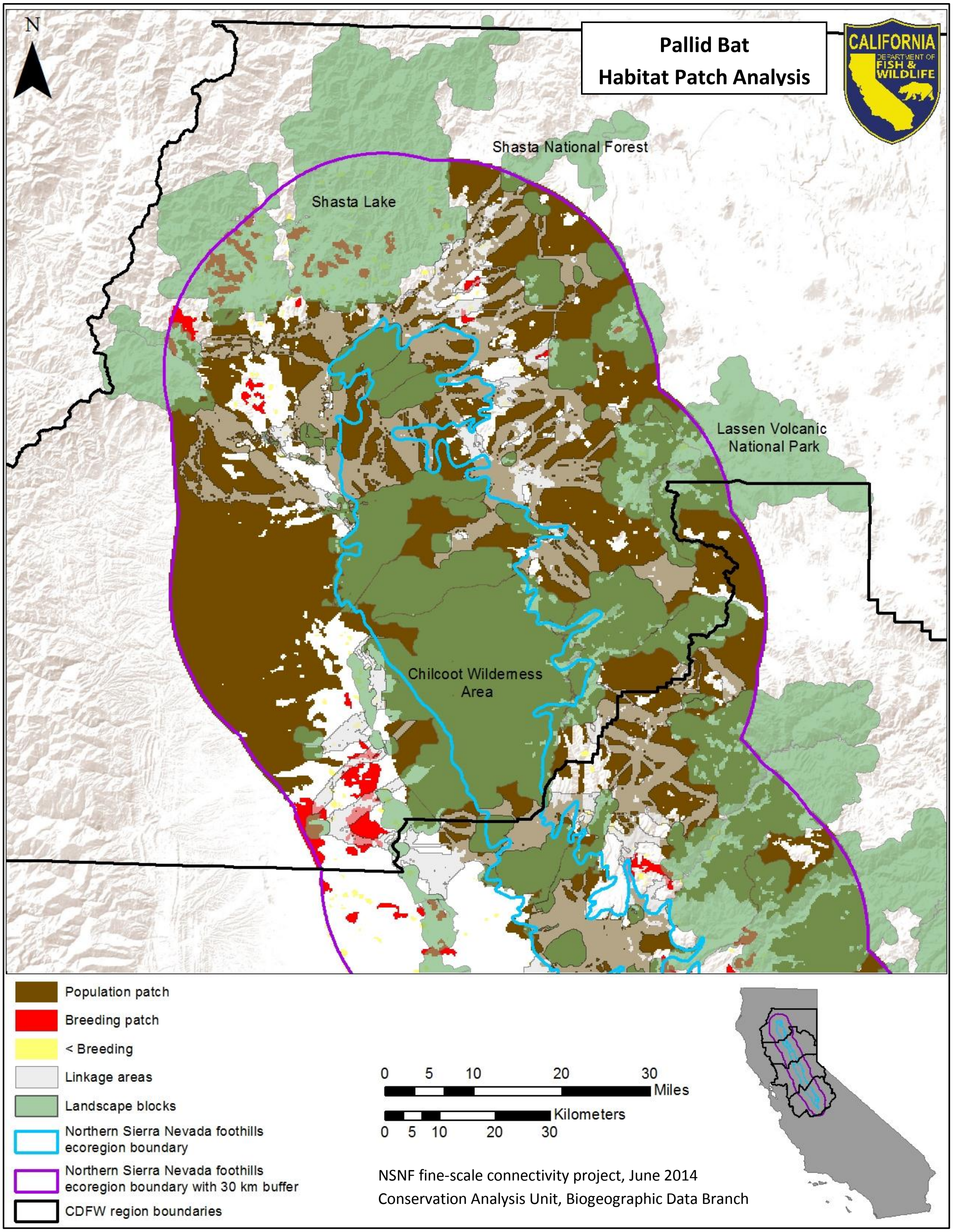


Figure S-104. Habitat patch analysis for the pallid bat (*Antrozous pallidus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >8,625 ha; breeding patches were contiguous areas of suitable habitat >135 ha.

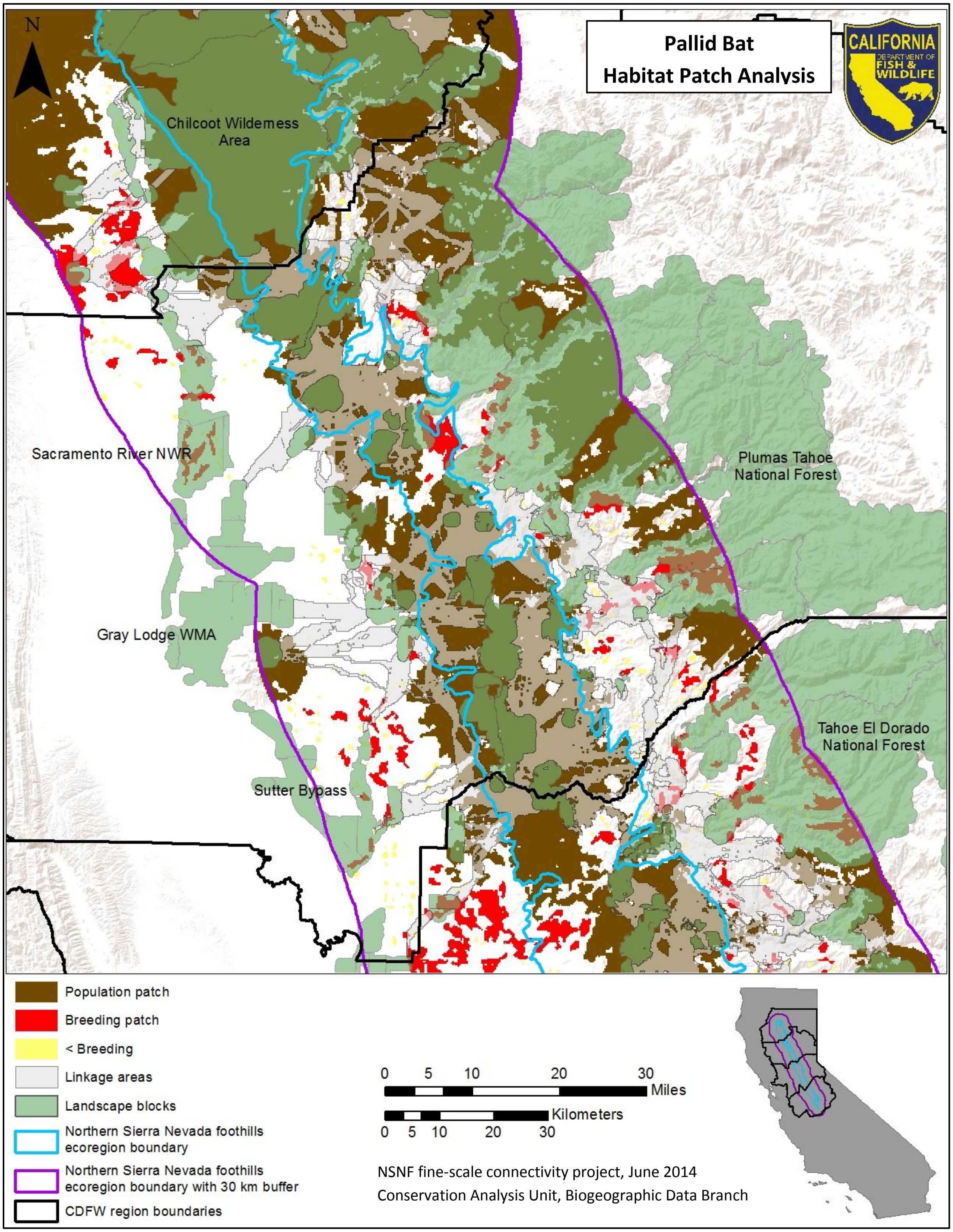


Figure S-105. Habitat patch analysis for the pallid bat (*Antrozous pallidus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >8,625 ha; breeding patches were contiguous areas of suitable habitat >135 ha.

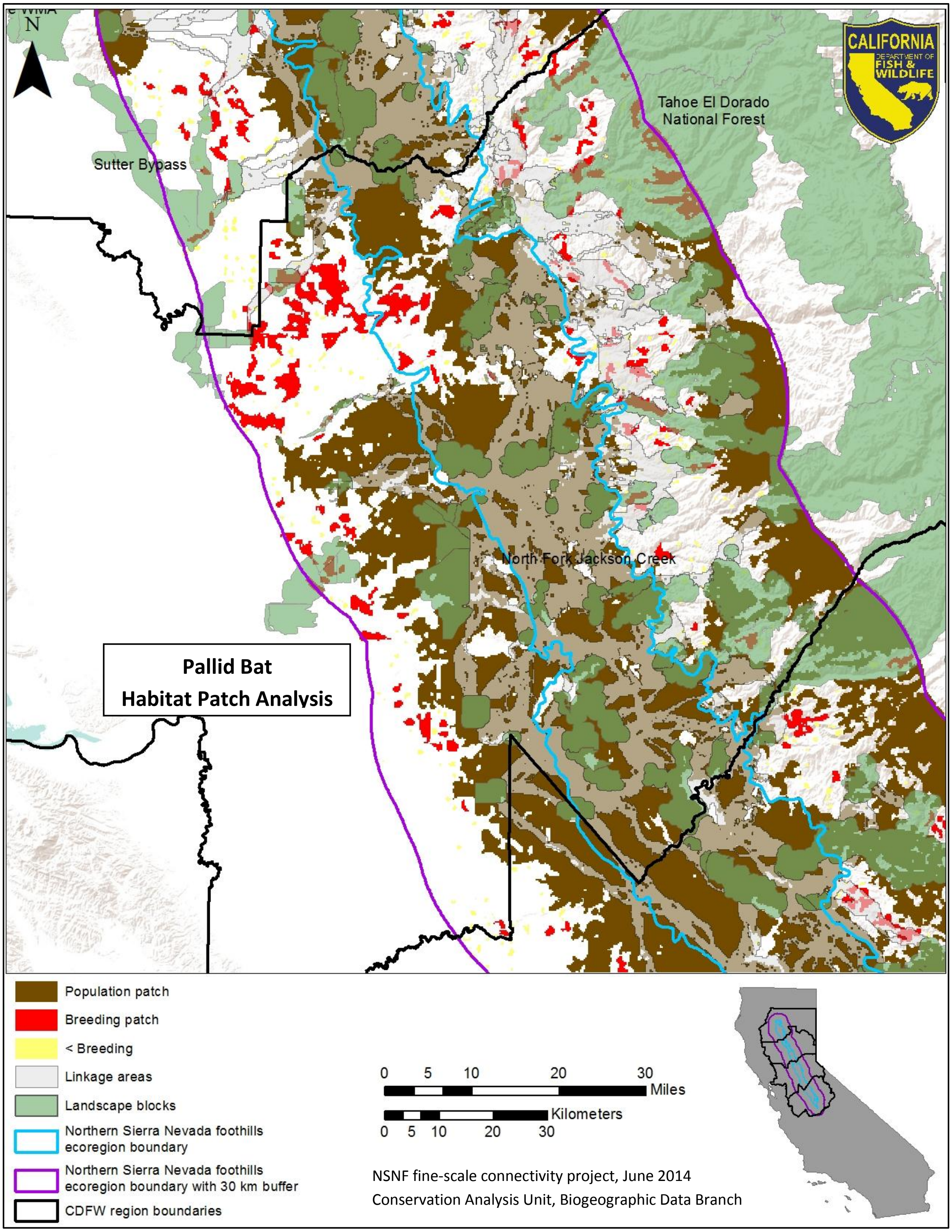


Figure S-106. Habitat patch analysis for the pallid bat (*Antrozous pallidus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >8,625 ha; breeding patches were contiguous areas of suitable habitat >135 ha.

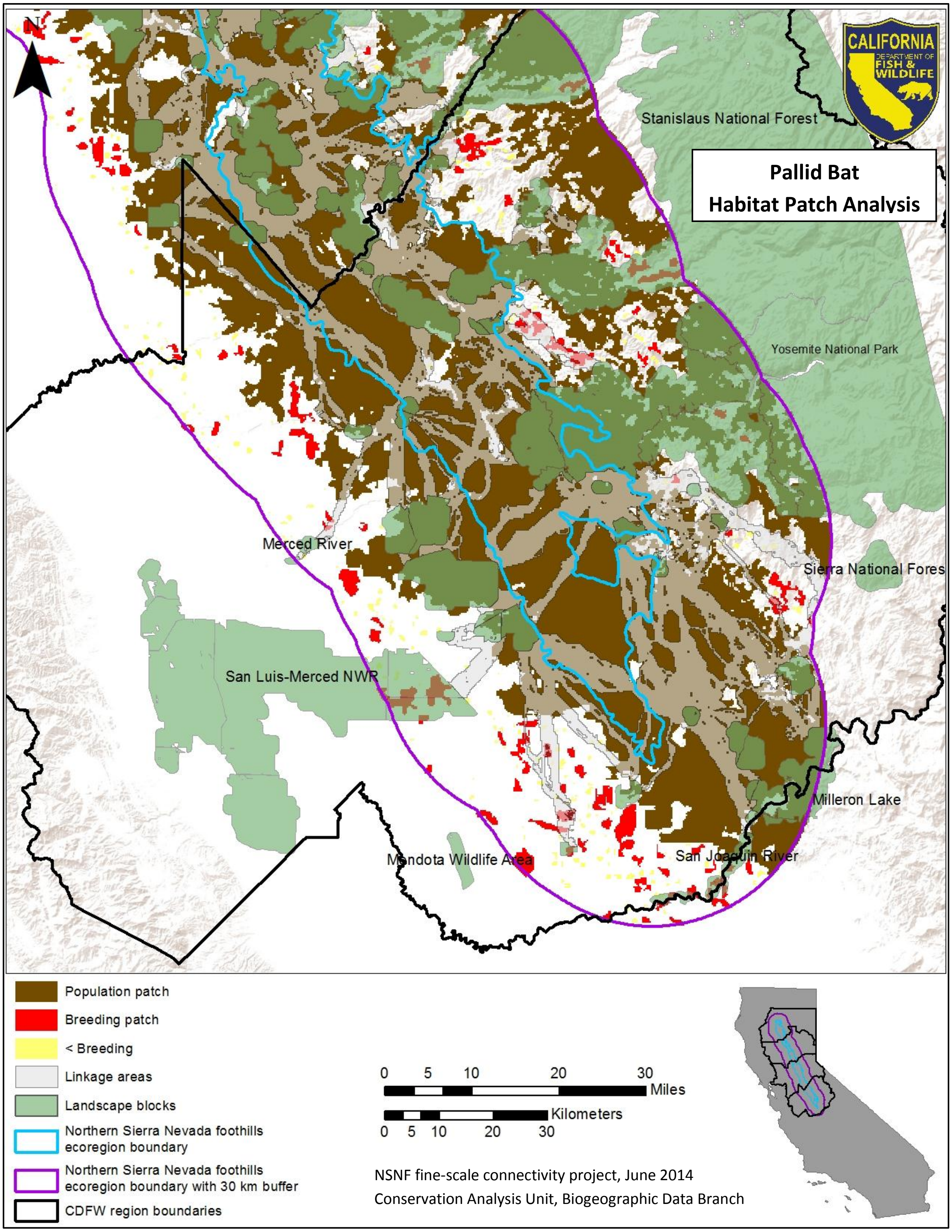


Figure S-107. Habitat patch analysis for the pallid bat (*Antrozous pallidus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >8,625 ha; breeding patches were contiguous areas of suitable habitat >135 ha.

Racer (*Coluber constrictor*)

Focal species selection: The racer is a common snake in California, absent only from the high mountains of the Sierra Nevada, the deserts, and most of the floor of the San Joaquin Valley (CWHR 2008). The elevational range of racers are from sea level to 2530 m (Stebbins 1985). Racers are found in many habitat types within their range in California, most common in open country and generally absent from densely forested habitats (CWHR 2008). No information on water requirements were found. Racers can be found under surface objects such as flat rocks, logs and debris; hibernate in rock piles, small caves and in mammal burrows (CWHR 2008). The racer was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for racer were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 220 location points to train each model, 56 to test each model, and 9930 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range In Utah, racers were found to have an average home range size of 0.38 ha (Brown and Parker 1976). Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: In colder regions racers may return to the same area to hibernate and migrate up to 1.8 km to and from their warm season areas of activity (Brown and Parker 1976). Maximum dispersal distance used was 1.8 km.

Results and Discussion: The selected racer habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.60. The model predicted 3,716,274.3 ha of suitable habitat. The patch analysis identified 428 breeding patches covering 4,082.0 ha and 902 population patches covering 2,861,755.5 ha. Two hundred twenty-four of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages.

Habitat patches covered 86.8% of the total corridor area. Racer habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 47.7% of habitat area in the corridors had high predicted suitability, 18.6% medium and 33.7% low.

Potential habitat for racer is widespread throughout the foothills and western side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with scattered patches on the eastern side between Chilcooth WA and Lassen Volcanic National Park and Shasta NF blocks. The linkages capture most of the habitat patches in the region.

Region 2 North: Habitat is limited to the foothills and western side in this region with only scattered patches on the eastern side of the study area. Habitat patches on the eastern side near Chilcoot WA and Plumas-Tahoe NF are isolated. Habitat patches in the foothills and western side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is scattered throughout this region of the study area. Habitat patches on the western side near the Cosumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat is fairly continuous in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.60	n/a	3,716,274.3	2,865,837.9	1,330

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
55.0	13.4	31.6

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
224	86.8	33.7	18.6	47.7

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
25.9	58.6	63.8	42.2

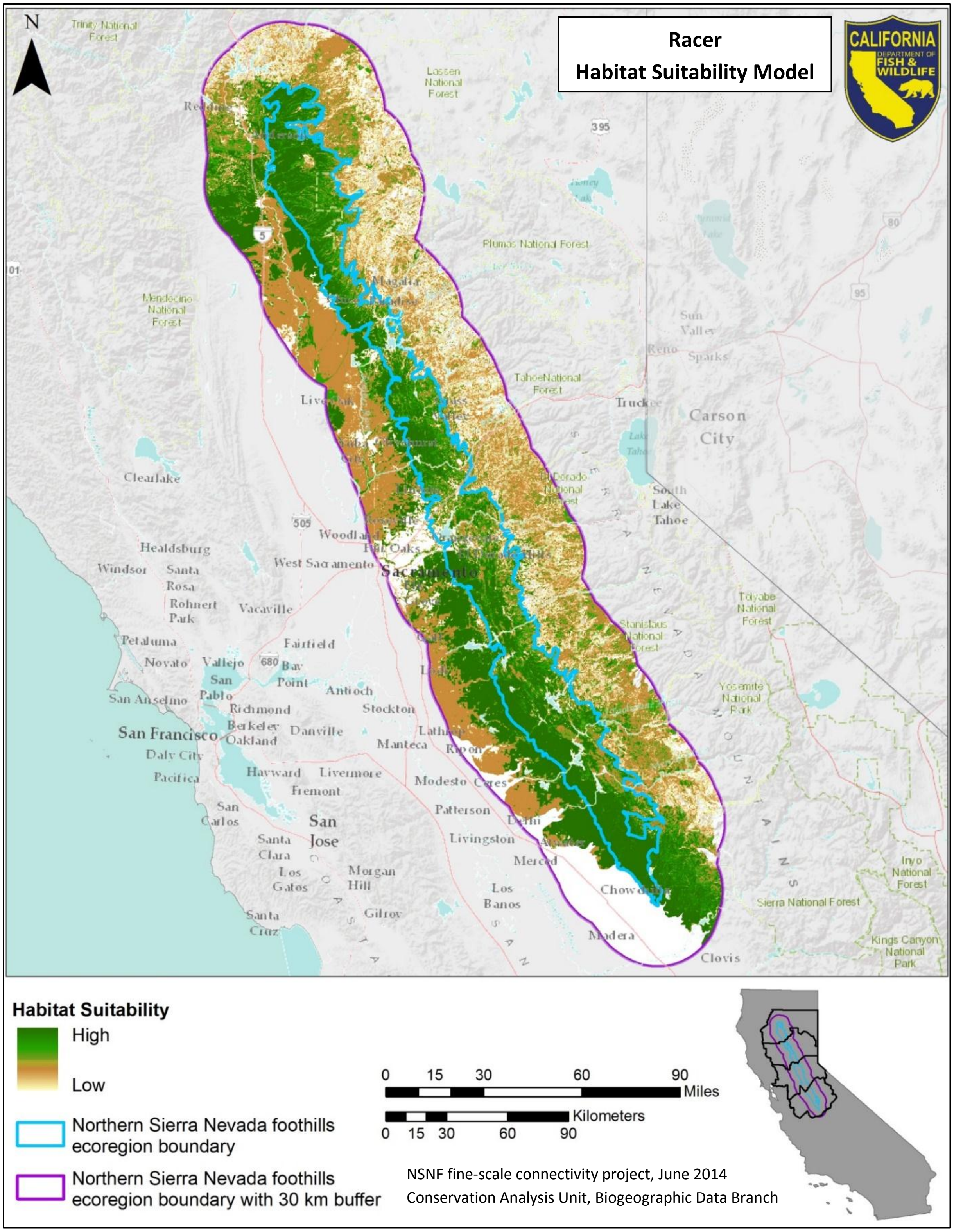


Figure S-108. Predicted habitat suitability for the racer (*Coluber constrictor*). Environmental variables for the CWHR Bioview model were defined from vegetation, size, and density for 63 vegetation classes**.**

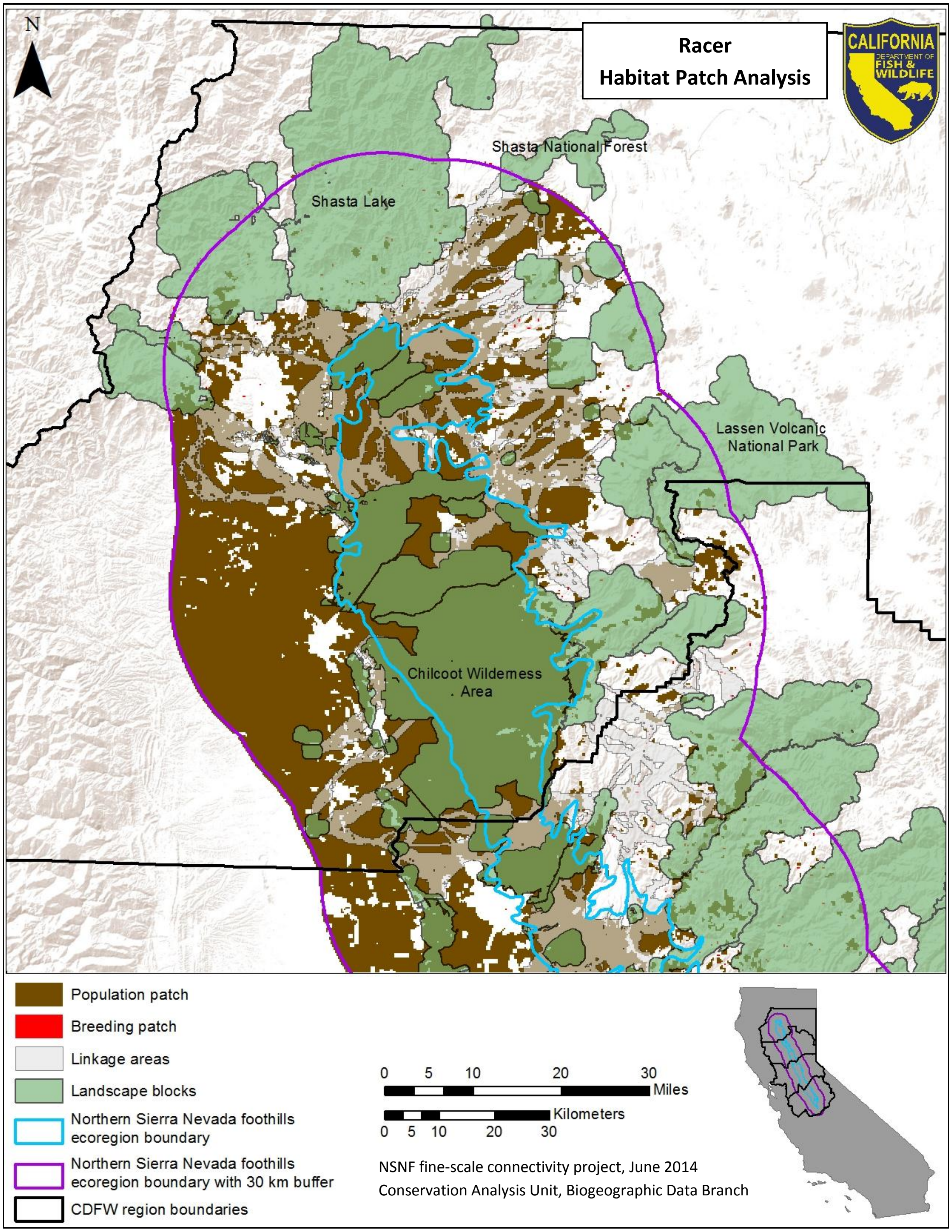


Figure S-109. Habitat patch analysis for the racer (*Coluber constrictor*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

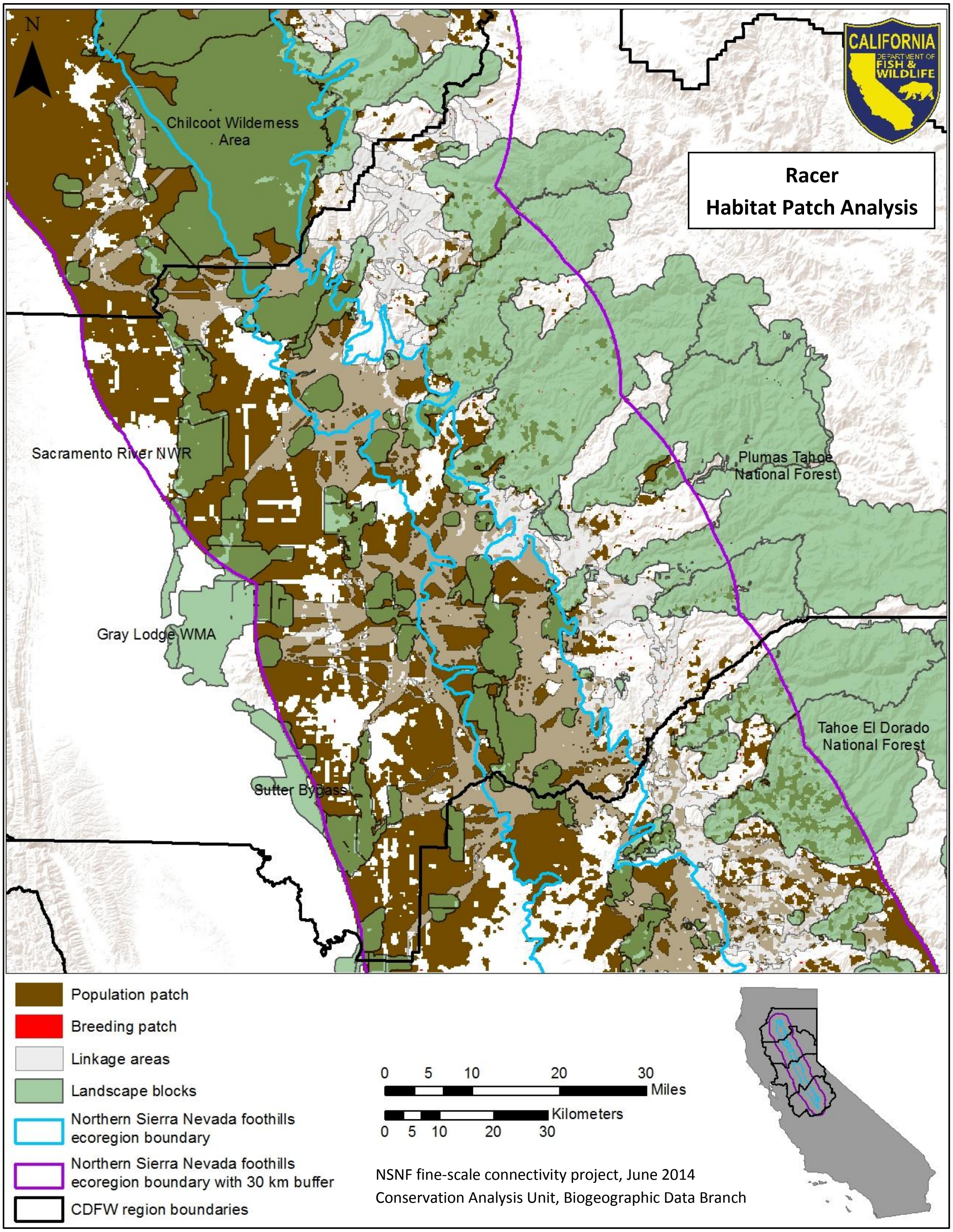


Figure S-110. Habitat patch analysis for the racer (*Coluber constrictor*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

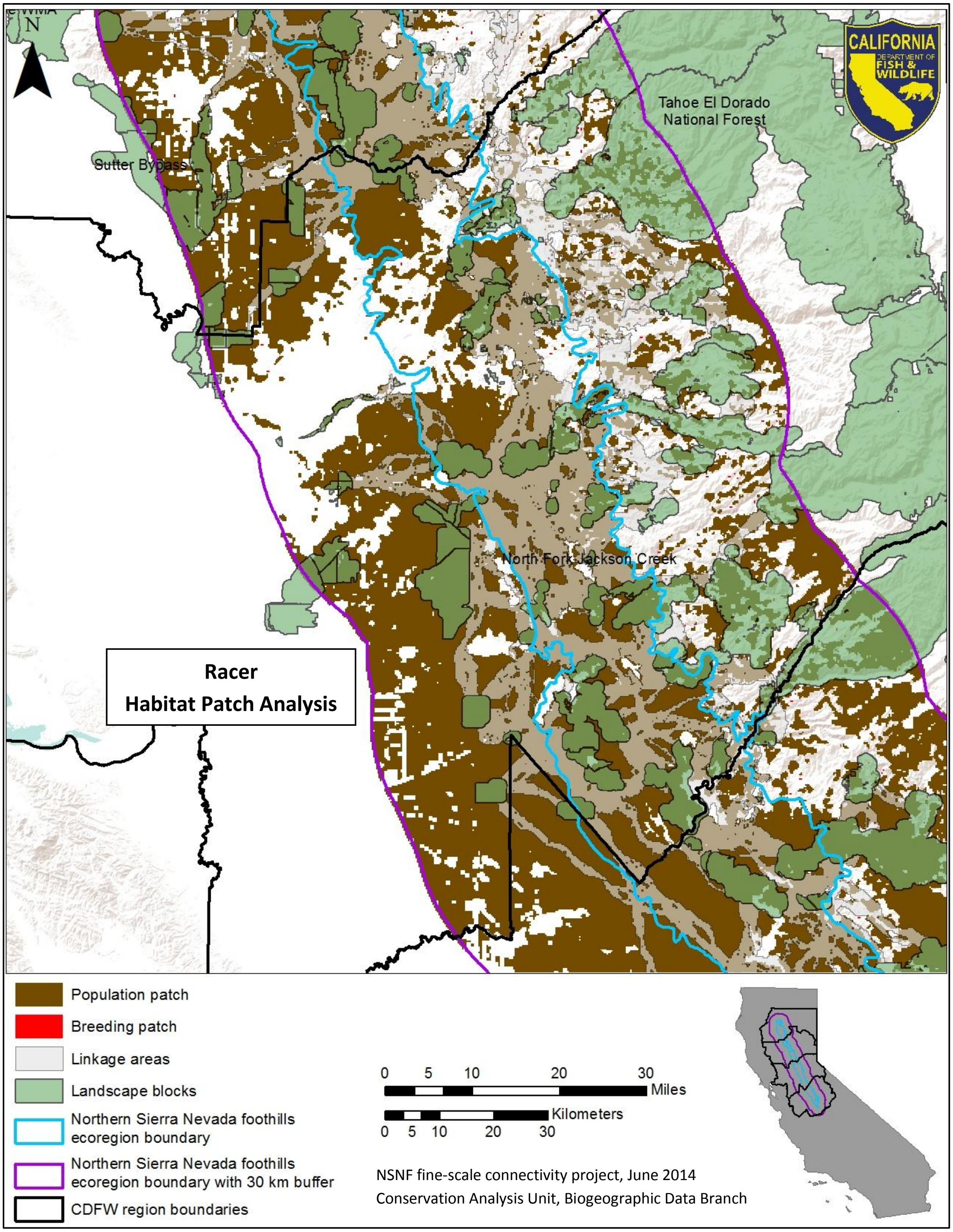


Figure S-111. Habitat patch analysis for the racer (*Coluber constrictor*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

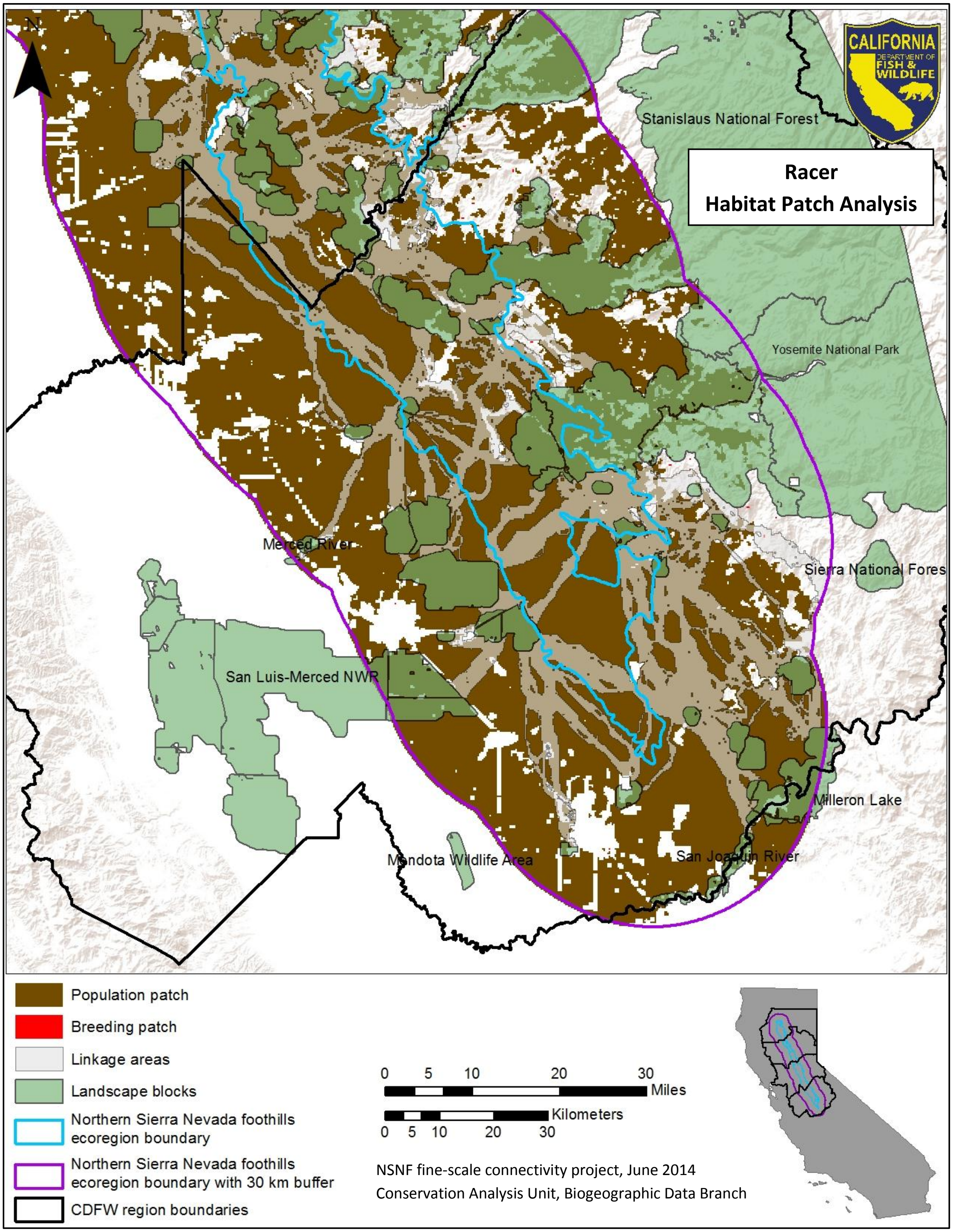


Figure S-112. Habitat patch analysis for the racer (*Coluber constrictor*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >25 ha; breeding patches were contiguous areas of suitable habitat >1 ha.

Southern alligator lizard (*Elgaria multicarinata*)

Focal species selection: The Southern alligator lizard is widespread in northern and central California west of the Sierra-Cascade crest, and in southern California west of the desert regions (CWHR 2008). The elevational range of the Southern alligator lizard is from sea level to 2,250 m. The species occurs most commonly in valley-foothill habits, mixed chaparral, and in open areas of mix conifer forest (CWHR 2008). No information on water requirements was found. This lizard occurs in areas of low rainfall and often far from any source of standing water, although Dawson and Templeton (1966) report relatively high rates of evaporative water loss at normal active body temperature. The Southern alligator lizard was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for Southern alligator lizard were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 986 location points to train each model, 247 to test each model, and 9735 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: No information was found regarding home range. Minimum breeding patch size used was 2 ha; minimum population patch size was 20 ha.

Dispersal/Migration: The species is non-migratory; predictable seasonal movements have not been recorded in California. Maximum dispersal distance used was 300 m.

Results and Discussion: The selected southern alligator lizard habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.85. The mean probability threshold was 0.27 predicting 2,946,800.3 ha of suitable habitat. The patch analysis identified 213 breeding patches covering 2,062.6 ha and 415 population patches covering 2,245,728.2 ha. One hundred forty-five of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 76.5% of the total corridor area. Southern alligator lizard habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 36.4% of habitat area in the corridors had high predicted suitability, 56.6% medium and 7% low.

Potential habitat for southern alligator lizard is widespread throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with isolated patches on the western side between Whiskeytown-Shasta-Trinity NRA and Chilcoot WA and in the south between Chilcooth WA and Plumas-Tahoe NF. The linkages capture most of the habitat patches in the north between Chilcoot WA and Shasta Lake.

Region 2 North: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Sacramento River NWR are isolated from the Chico block. Habitat patches near Sutter Buttes block are also isolated from the main foothill blocks. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the American River Parkway block and Napa-Sonoma Marshes Wildlife Area block are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat is limited to the foothills and eastern side in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.85	0.27	2946800.3	2247791.3	628

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
22.7	54.9	22.4

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
145	76.5	7.0	56.6	36.4

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
26.6	52.8	79.0	52.7

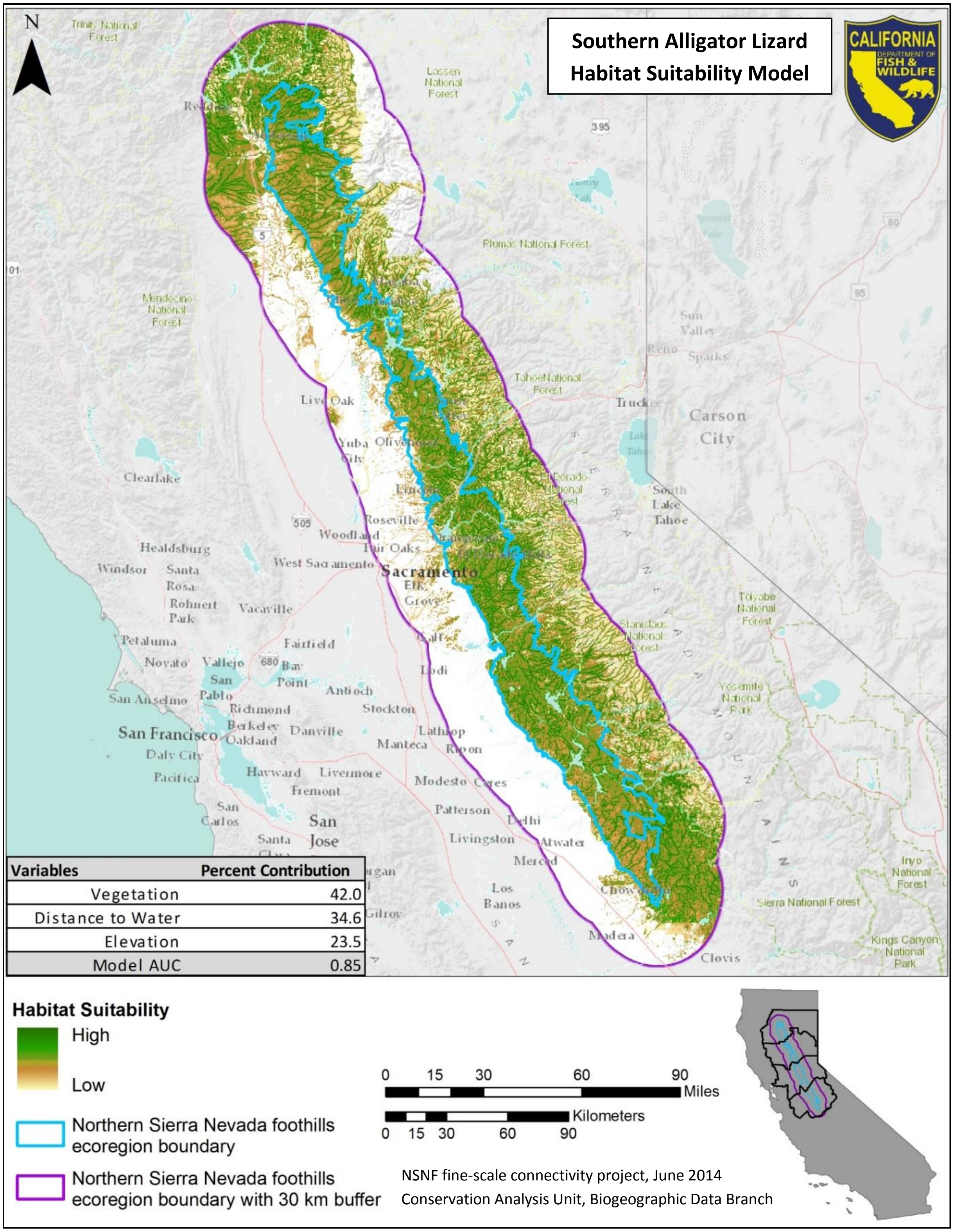


Figure S-113. Predicted habitat suitability for the southern alligator lizard (*Elgaria multicarinata*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

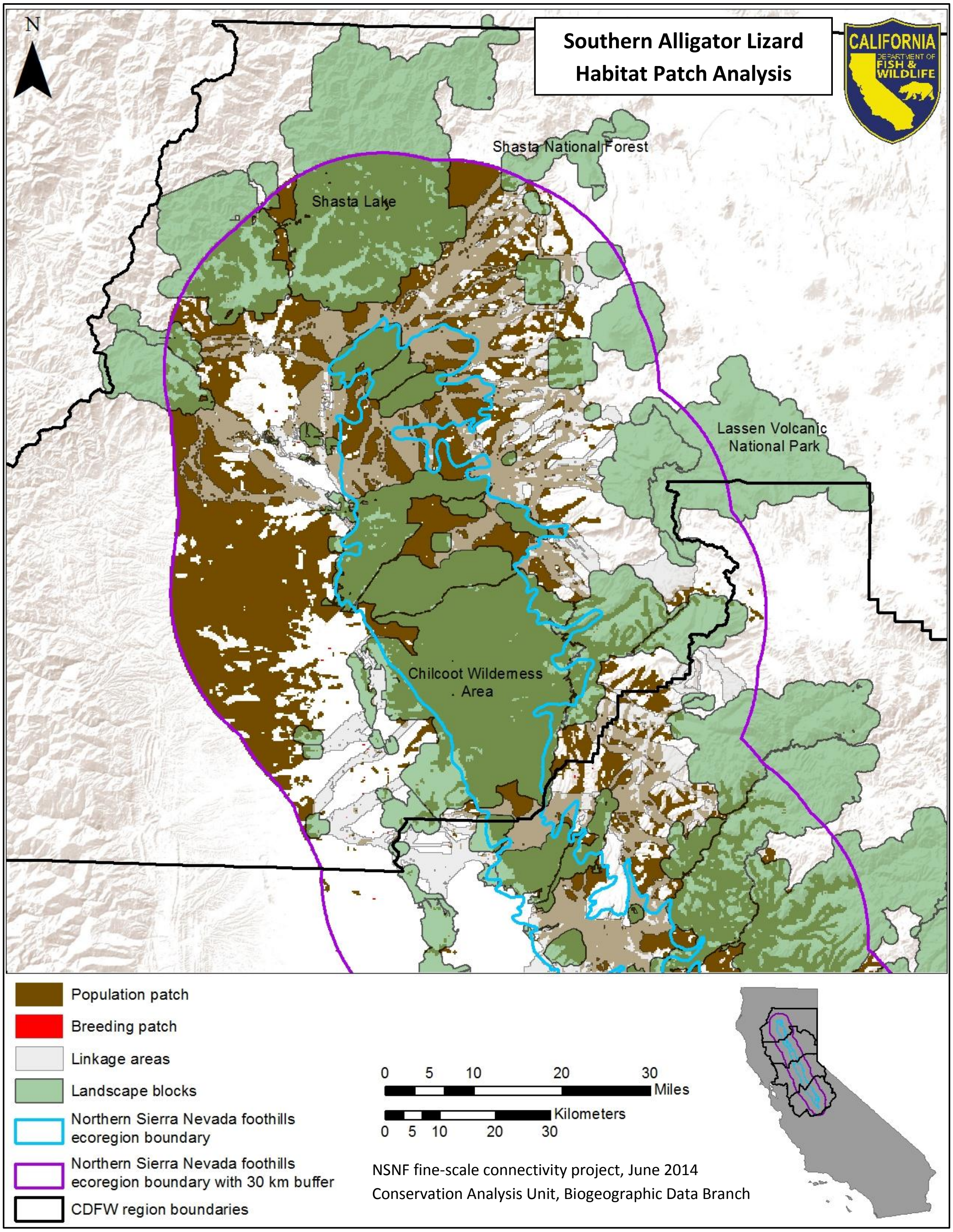


Figure S-114. Habitat patch analysis for the southern alligator lizard (*Elgaria multicarinata*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >20 ha; breeding patches were contiguous areas of suitable habitat >2 ha.

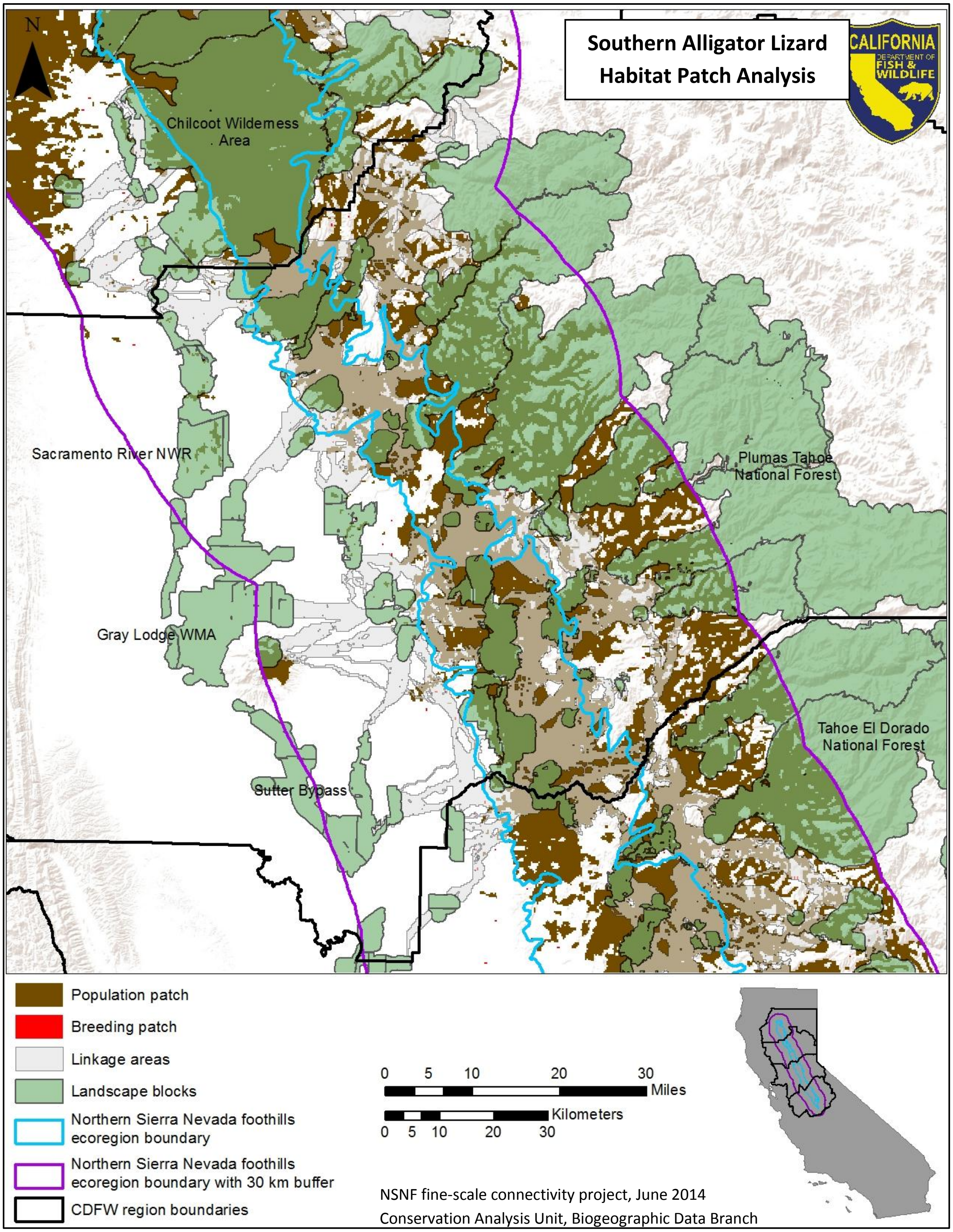


Figure S-115. Habitat patch analysis for the southern alligator lizard (*Elgaria multicarinata*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >20 ha; breeding patches were contiguous areas of suitable habitat >2 ha.

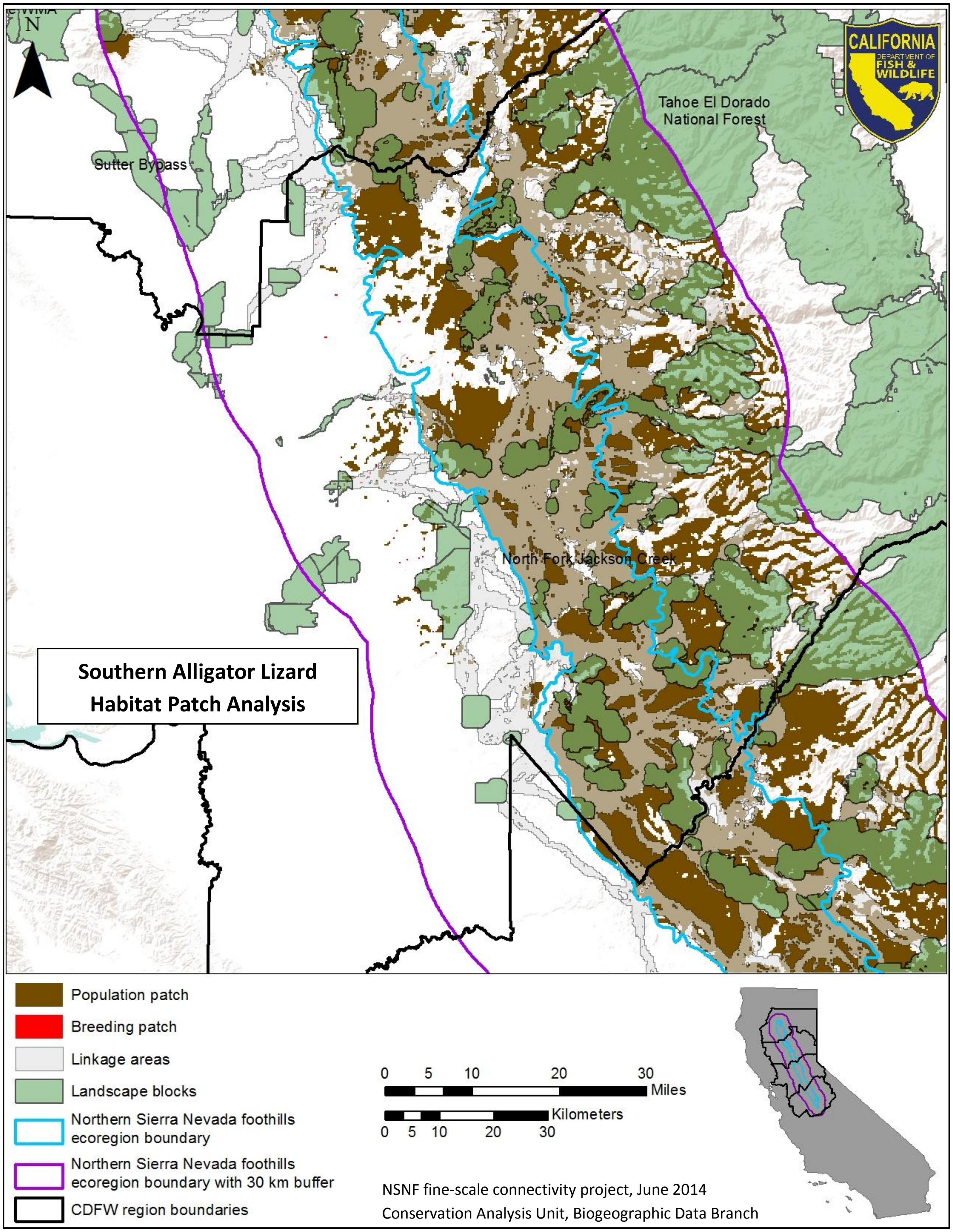


Figure S-116. Habitat patch analysis for the southern alligator lizard (*Elgaria multicarinata*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >20 ha; breeding patches were contiguous areas of suitable habitat >2 ha.

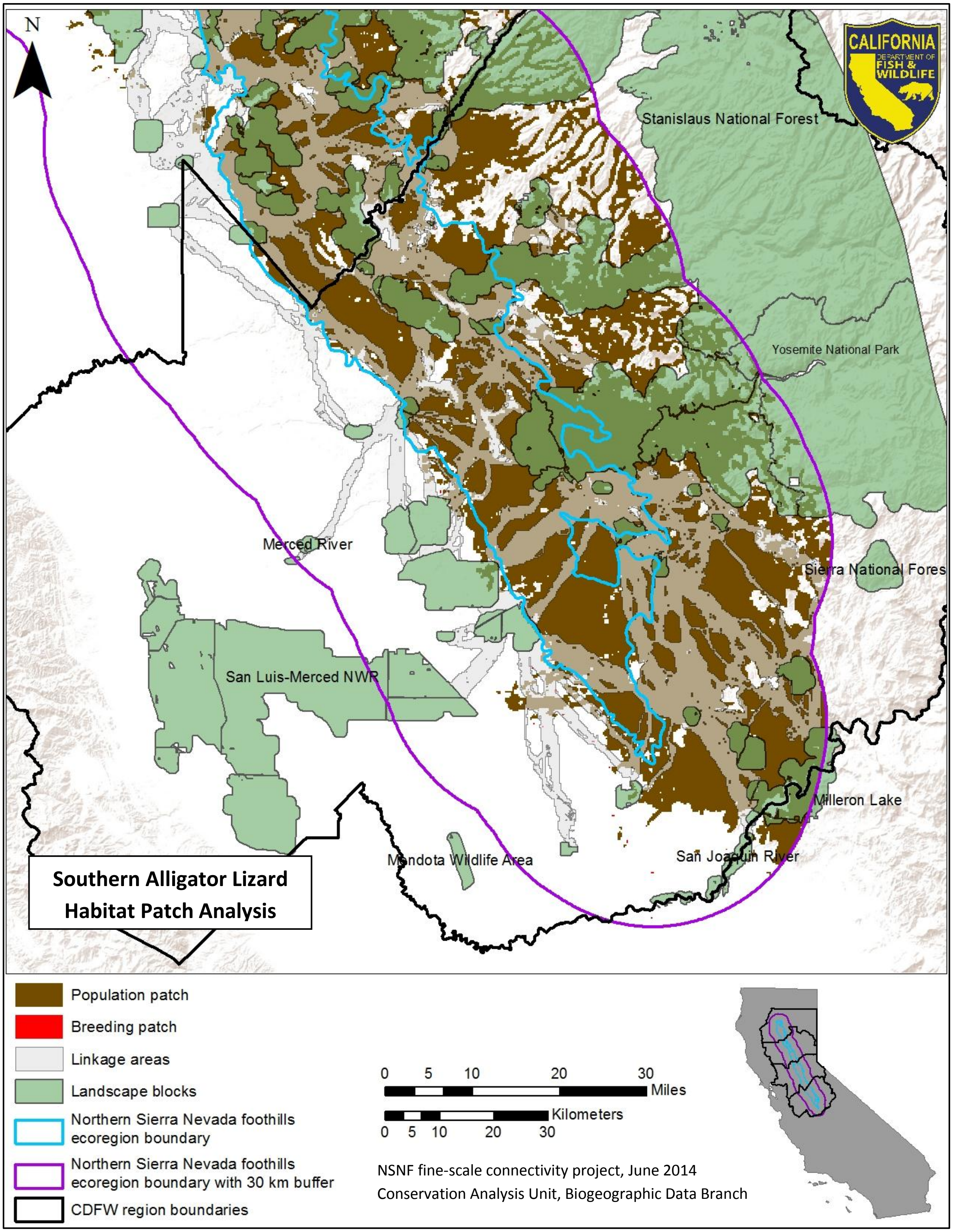


Figure S-117. Habitat patch analysis for the southern alligator lizard (*Elgaria multicarinata*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >20 ha; breeding patches were contiguous areas of suitable habitat >2 ha.

Spotted towhee (*Pipilo maculatus*)

Focal species selection: Spotted towhees are common residents throughout California except at high elevation in the Sierra Nevada and lowlands of southern deserts (CWHR 2008). They are found in chaparral and other shrub habitat and in open stands of riparian, hardwood, hardwood-conifer and lower-elevation conifer habitats (CWHR 2008). The species occupies relatively tall, dense stands of shrub and riparian thickets with accumulations of leaf litter and humus, especially decadent stands and those at the bottom of slopes (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the spotted towhee was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for spotted towhee were the expert opinion CWHR Bioview, and Maxent scenarios 5 and 6. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 15,887 location points to train each model, 3972 to test each model, and 35,937 background points. Environmental variables for the Maxent scenario 5 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and a 15 class vegetation layer. Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Spotted towhee winter home range averaged 7 ha in Kansas (Fitch 1958). Breeding density, in numbers per 40 ha, was reported as 16-39 males in a Central Valley riparian area (Gaines 1974) and 54 pairs in California chaparral (Yeaton 1974). Minimum breeding patch size used was 5 ha; minimum population patch size was 100 ha.

Dispersal/Migration: In winter, the species generally moves downslope from montane habitats, at least in northern California and desert ranges (Grinnell and Miller 1944, McCaskie, DeBenedictis et al. 1979, Garrett and Dunn 1981). Maximum dispersal distance used was 2.1 km.

Results and Discussion: The selected spotted towhee habitat suitability model was CWHR Bioview. We evaluated model performance with AUC based on species location and background points from the Maxent models. AUC values are lower than the Maxent models because CWHR Bioview models are not based on species location data; model AUC was 0.59. The model predicted 3,185,649.8 ha of suitable habitat. The patch analysis identified 1,093 breeding patches covering 32,322.9 ha and 509 population patches covering 1,972,833.2 ha. One hundred sixty-five of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 79.4% of the total corridor area. Spotted towhee habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 20.2% of habitat area in the corridors had high predicted suitability, 30.9% medium and 48.9% low.

Potential habitat for spotted towhee is scattered throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with isolated patches on the western side between Whiskeytown-Shasta-Trinity NRA and Chilcoot WA. The linkages capture most of the habitat patches in the north and east between Chilcoot WA and Shasta Lake and Lassen Volcanic National Park.

Region 2 North: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Sacramento River NWR are isolated from the Chico block due to urbanization around the City of Chico. Habitat patches near Sutter Buttes is also isolated from the main foothill blocks. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Cosumnes River Ecological Reserve and Napa-Sonoma Marshes Wildlife Area are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the Merced River block south to the Medera block are isolated from the main foothill blocks. Habitat patches on the eastern side of the study area are fairly continuous and are captured by most linkages.

CWHR Bioview model AUC	Threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.59	n/a	3,185,649.8	2,005,156.4	1,602

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
63.6	20.4	16.0

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
165	79.4	48.9	30.9	20.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
29.8	58.5	48.9	38.7

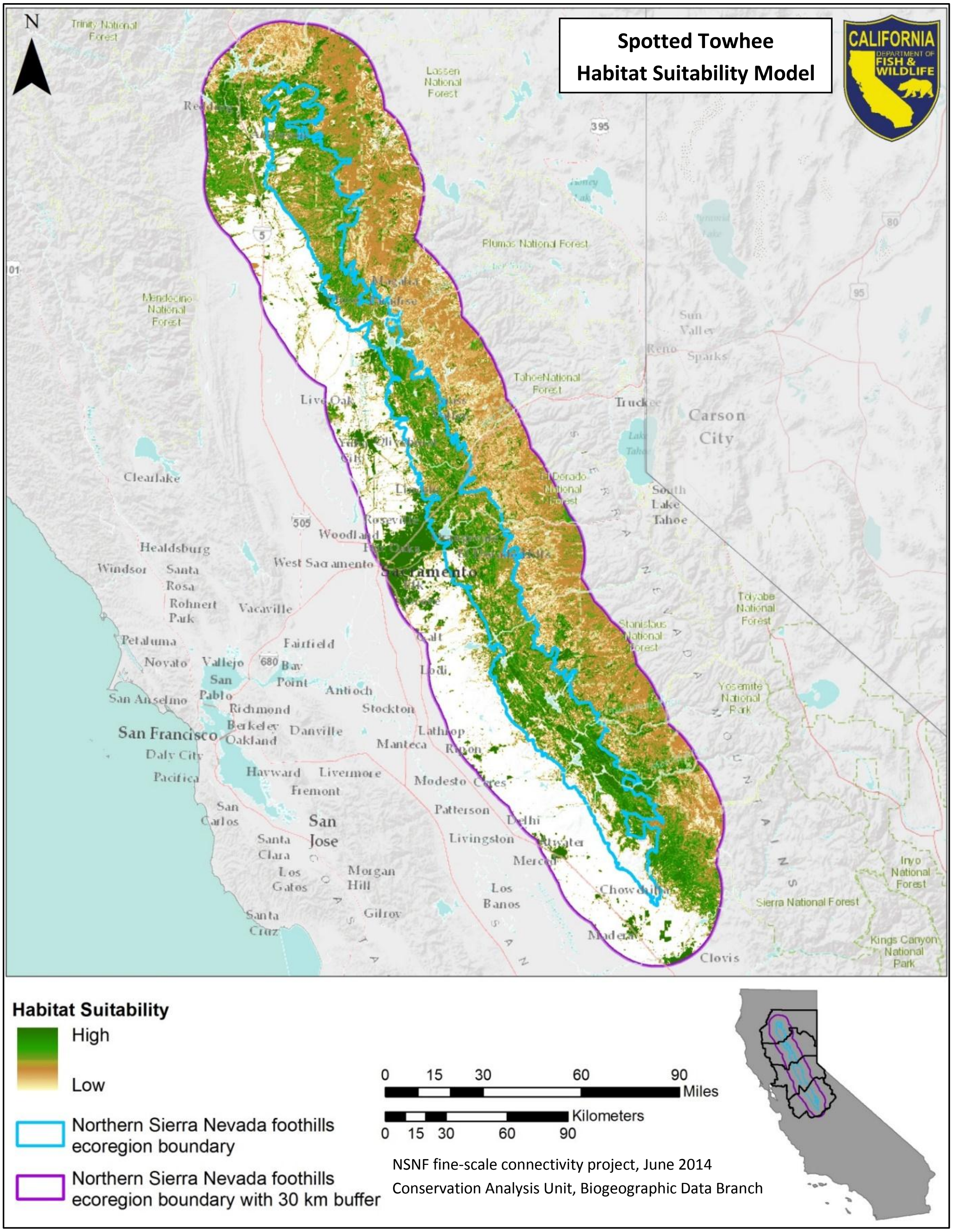


Figure S-118. Predicted habitat suitability for the spotted towhee (*Pipilo maculatus*). Environmental variables for the CWHR Bioview model were defined from vegetation, size and density for 63 vegetation classes**.**

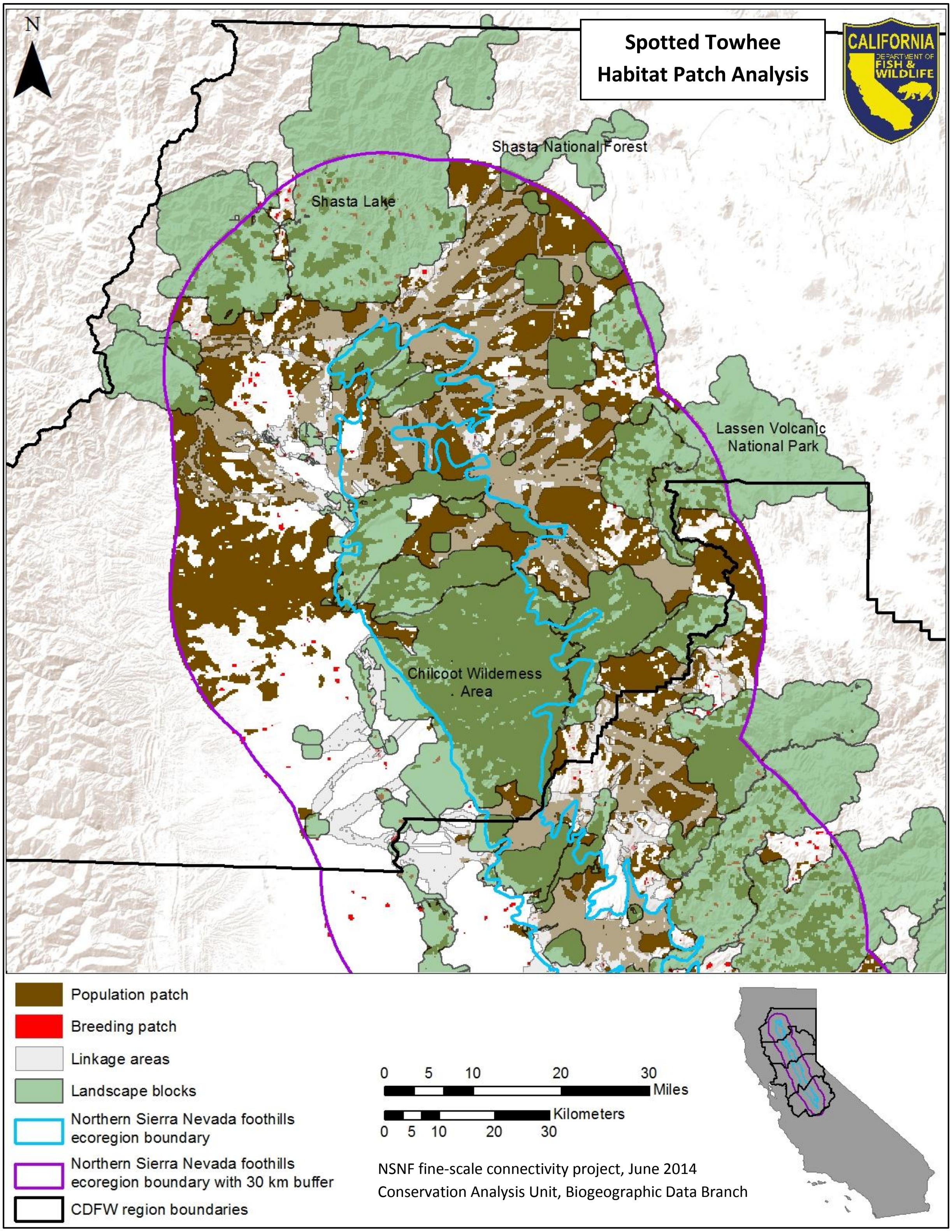


Figure S-119. Habitat patch analysis for the spotted towhee (*Pipilo maculatus*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >5 ha.

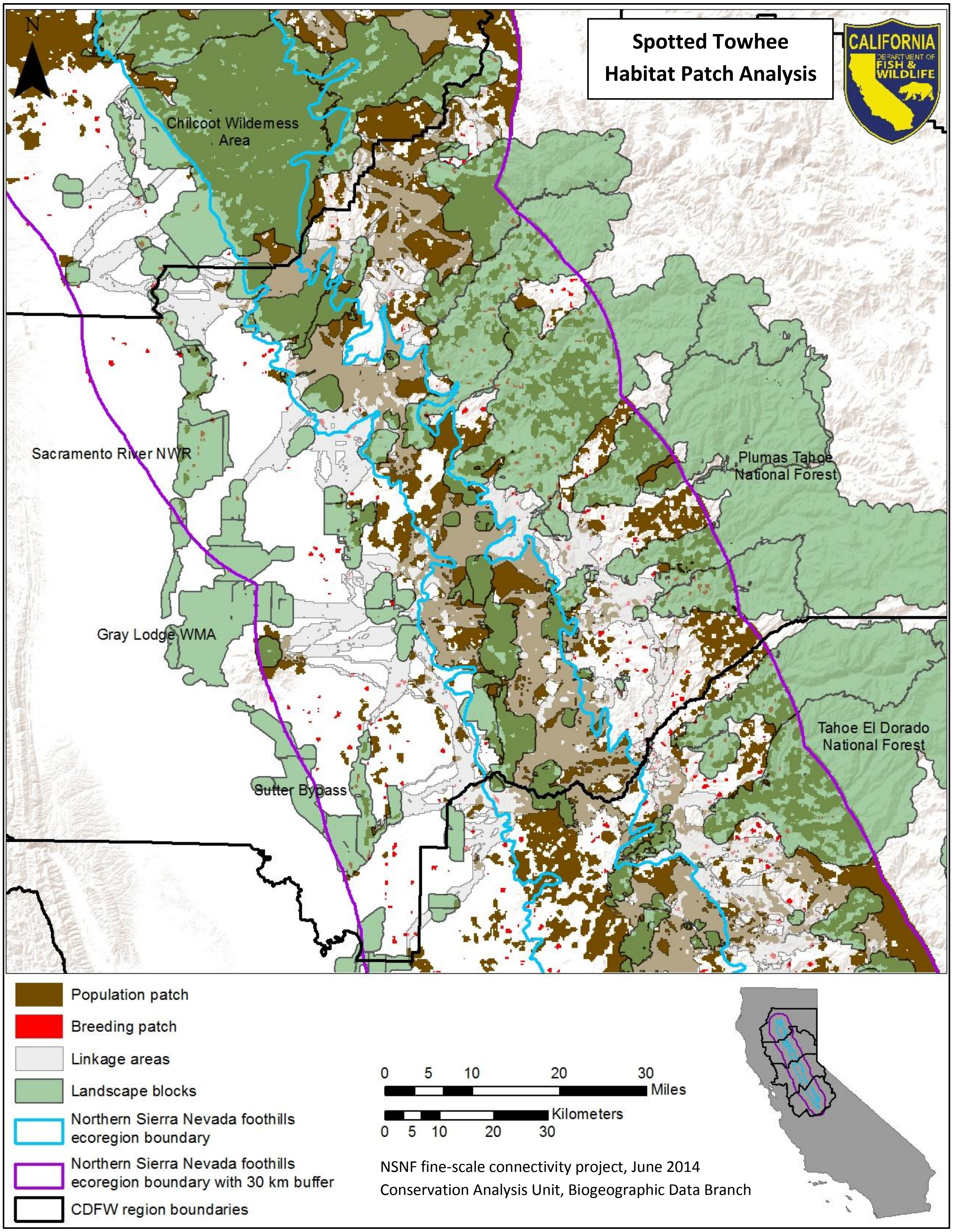


Figure S-120. Habitat patch analysis for the spotted towhee (*Pipilo maculatus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >5 ha.

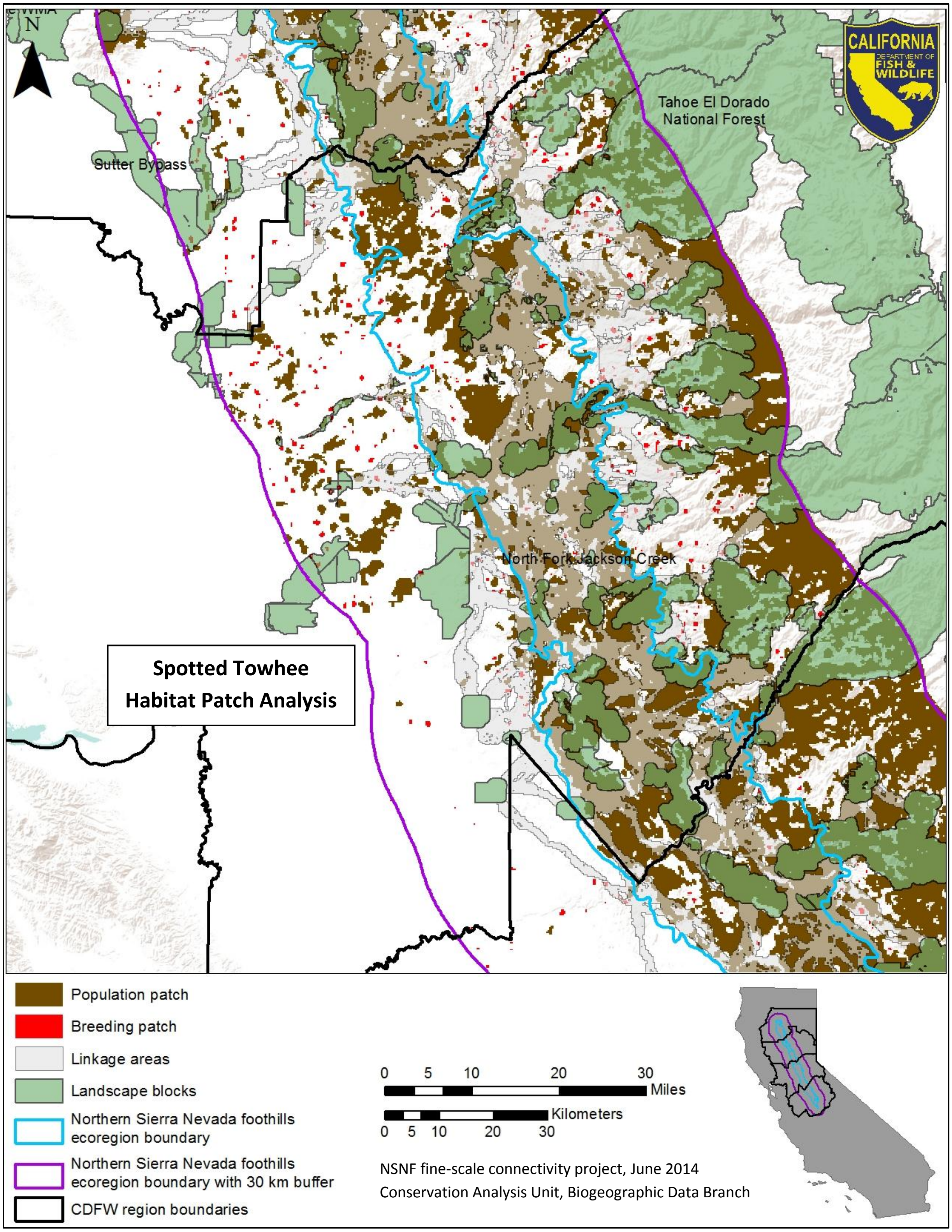


Figure S-121. Habitat patch analysis for the spotted towhee (*Pipilo maculatus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >5 ha.

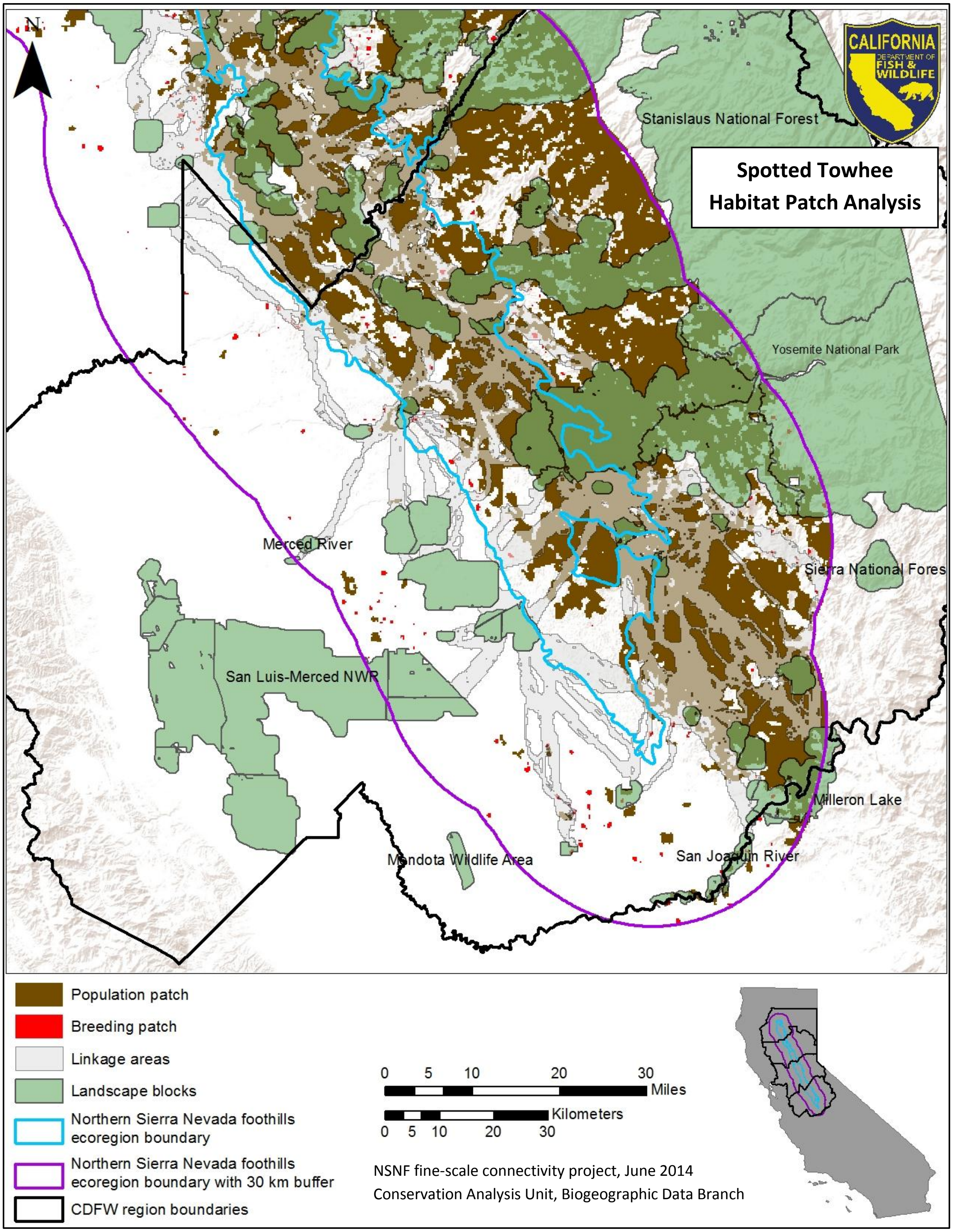


Figure S-122. Habitat patch analysis for the spotted towhee (*Pipilo maculatus*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >100 ha; breeding patches were contiguous areas of suitable habitat >5 ha.

Western gray squirrel (*Sciurus griseus*)

Focal Species Selection: Western gray squirrels are fairly common in mature stands of most conifer, hardwood and mixed hardwood-conifer habitats in Klamath, Cascade, Transverse, Peninsular and Sierra Nevada Ranges (Ingles 1965). They are also found in the Sacramento Valley in riparian stands and in other suitable habitats (CWHR 2008). These squirrels are **habitat specialists**, dependent upon mature stands of mixed conifer and oak habitats. They are closely associated with oaks and require large trees, mast and snags (CWHR 2008). Western gray squirrels have been observed lapping water from cavities and streams (CWHR 2008).

Habitat Model: The final three habitat suitability models developed for Western gray squirrel were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 376 location points to train each model, 95 to test each model, and 9886 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Western gray squirrel home range in the Sierra Nevada foothills varied from 0.2 to 0.7 ha for females and 0.5 to 1 ha for males (Ingles 1965). Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: The species is non-migratory. Maximum dispersal distance 5 km.

Results and Discussion: The selected Western gray squirrel habitat suitability model was Maxent scenario 9. The model performed well with an AUC of 0.90. The mean probability threshold was 0.18, predicting 2,586,871.1 ha of suitable habitat. The patch analysis identified 737 population patches covering 2,232,329.3 ha. We identified 99 Western gray squirrel least-cost corridors. Habitat patches covered 88.1% of the total corridor area. The majority of corridors were in the central foothills and eastern side of the study area and ranged in elevation from 37 m to 1,972 m. The least-cost corridors covered 461,170 ha of land, of those 18% were designated as GAP 1, 2 or 3 lands or in conservation easements, 82% are private lands. Western gray squirrel corridors covered many different vegetation types: 30% of the total corridor area was in oak woodland, 17% in grassland, 13% in hardwood and 13% in mixed conifer. Western gray squirrel habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 9.3% of habitat area in the corridors had high predicted suitability, 27.7% medium and 63% low.

Potential habitat for the Western gray squirrel is widespread throughout the foothills and eastern side of the study area.

Region 1: Most habitat patches are continuous throughout the northern region, with isolated patches on the western side near Chilcoot WA block and between Chilcooth WA and Cow Creek blocks. Nineteen of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat is limited to the foothills and eastern side in this region of the study area. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Twenty-nine of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat is limited to the foothills and eastern side in this region with only scattered patches on the western side of the study area. Habitat patches on the western side near the American River Parkway 2 and Napa-Sonoma Marshes Wildlife Area blocks are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Thirty-seven of the corridors are in this region of the study area and capture most of the habitat patches.

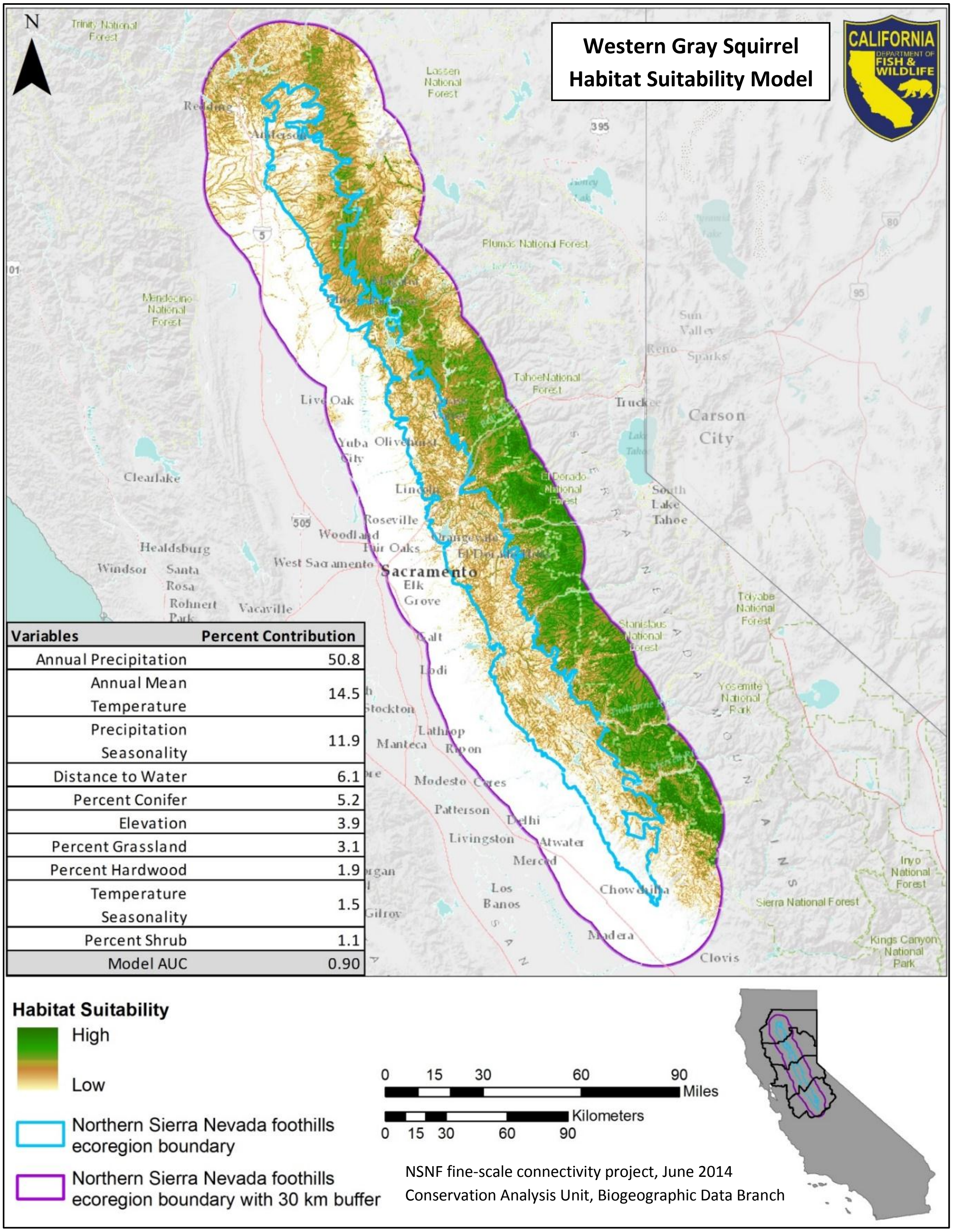
Region 4: Habitat is limited to eastern side in this region with only scattered patches in the foothills of the study area. Habitat patches in the central foothills are isolated from western blocks. Habitat patches on the eastern side of the study area are fairly continuous. Nineteen of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.90	0.18	2,586,871.1	2,232,329.3	737

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
65.6	29.7	4.7

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
99	88.1	63.0	27.7	9.3

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
15.9	15.4	32.9	16.6



Variables	Percent Contribution
Annual Precipitation	50.8
Annual Mean Temperature	14.5
Precipitation Seasonality	11.9
Distance to Water	6.1
Percent Conifer	5.2
Elevation	3.9
Percent Grassland	3.1
Percent Hardwood	1.9
Temperature Seasonality	1.5
Percent Shrub	1.1
Model AUC	0.90

Figure S-123. Predicted habitat suitability for the western gray squirrel (*Sciurus griseus*). Environmental variables for the Maxent scenario 9 included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

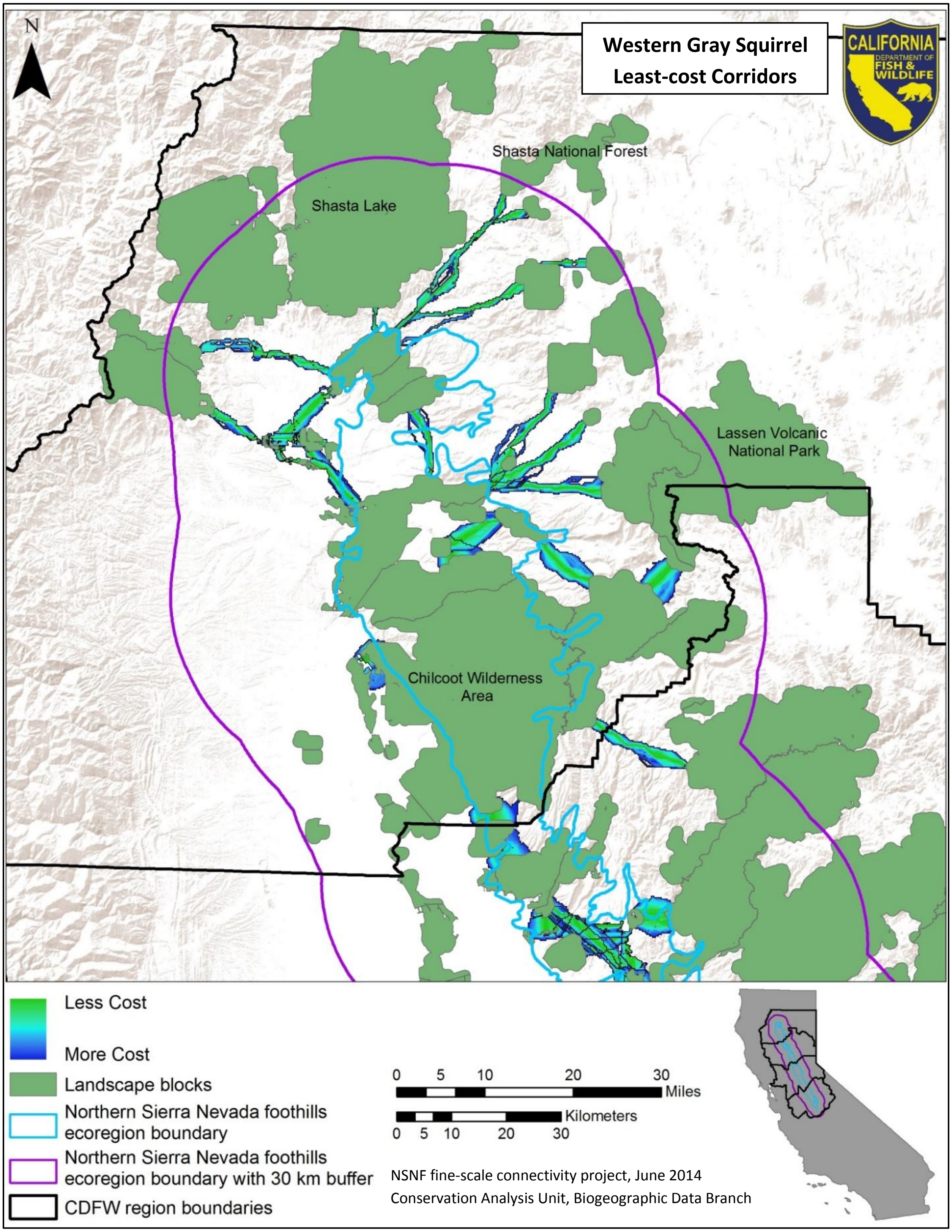


Figure S-124. Least-cost corridor analysis for the western gray squirrel (*Sciurus griseus*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

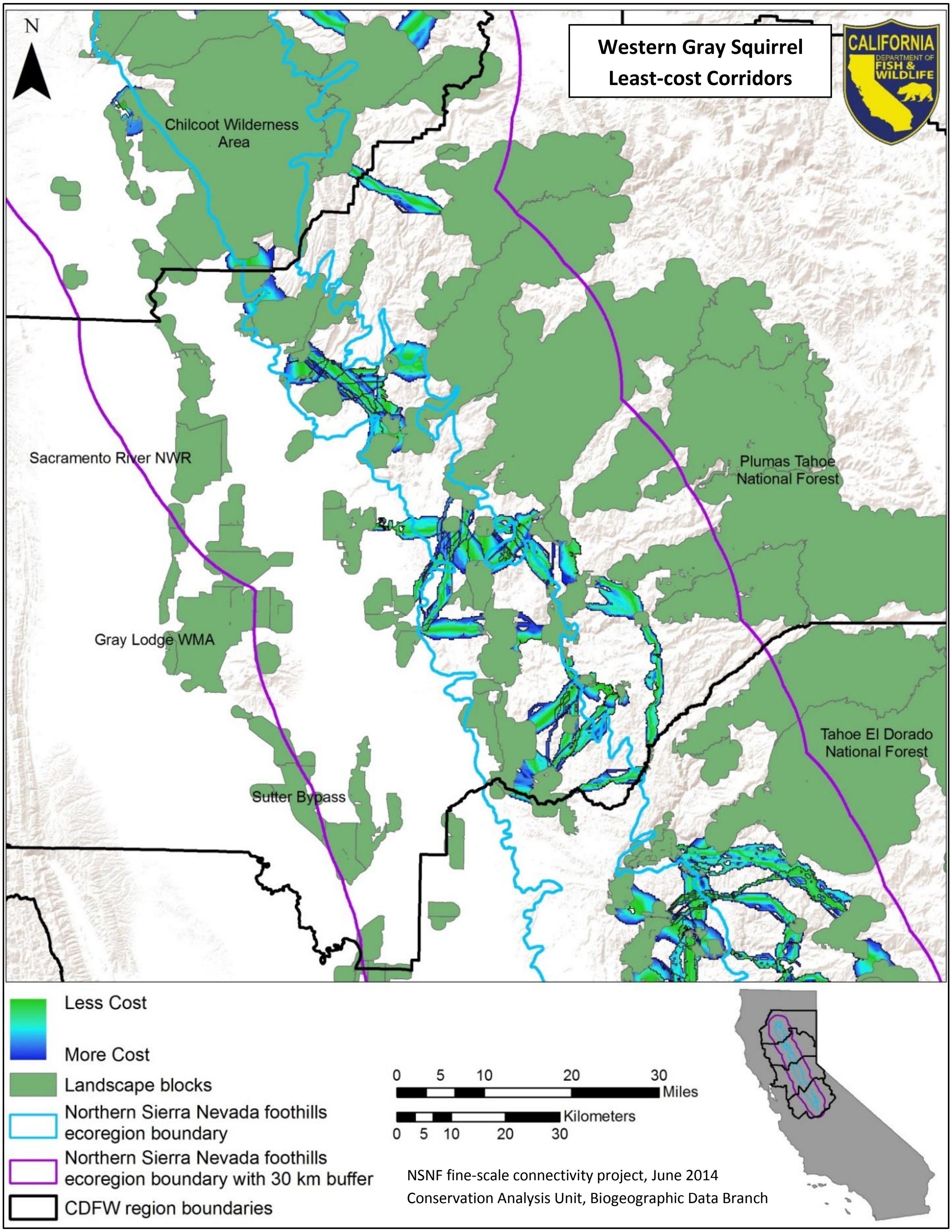


Figure S-125. Least-cost corridor analysis for the western gray squirrel (*Sciurus griseus*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

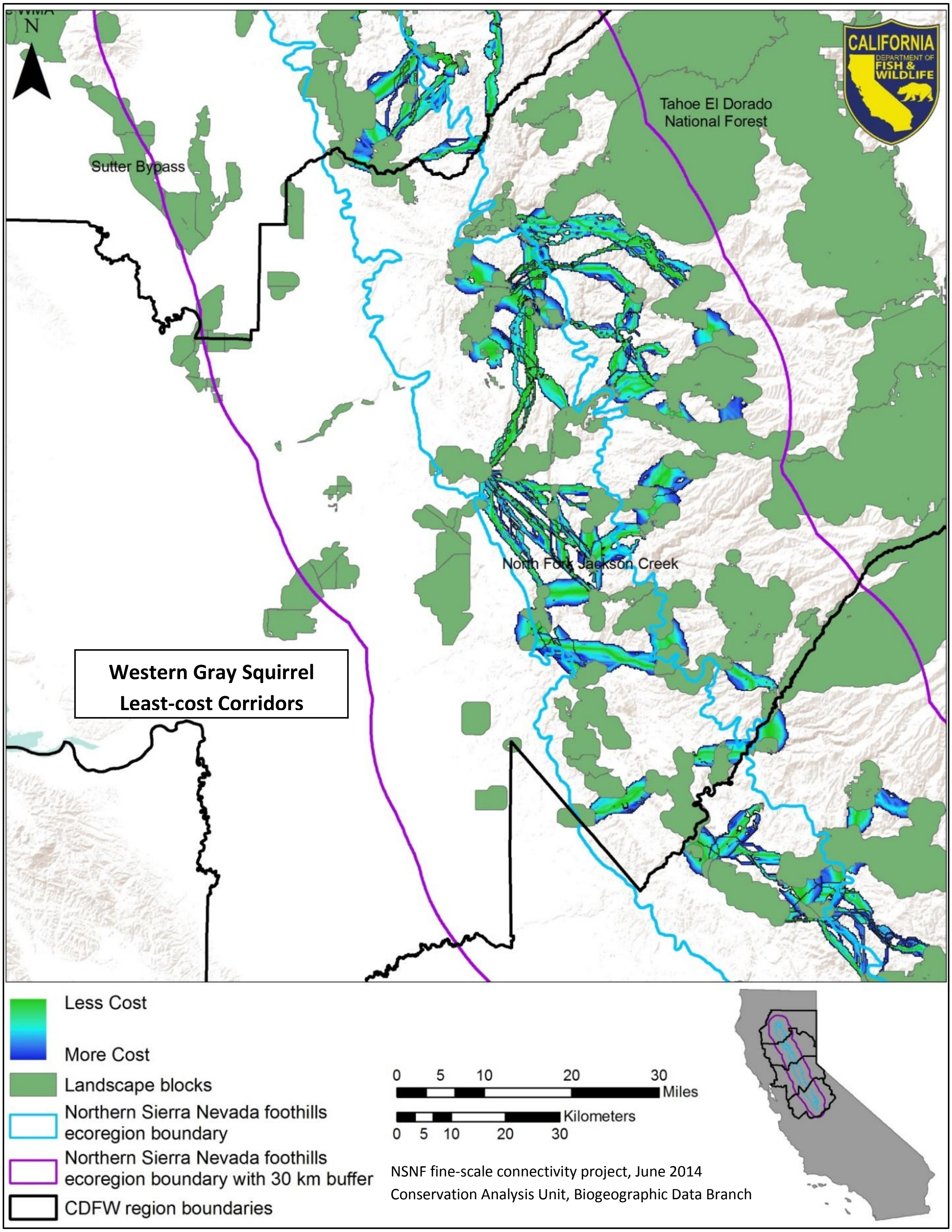


Figure S-126. Least-cost corridor analysis for the western gray squirrel (*Sciurus griseus*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

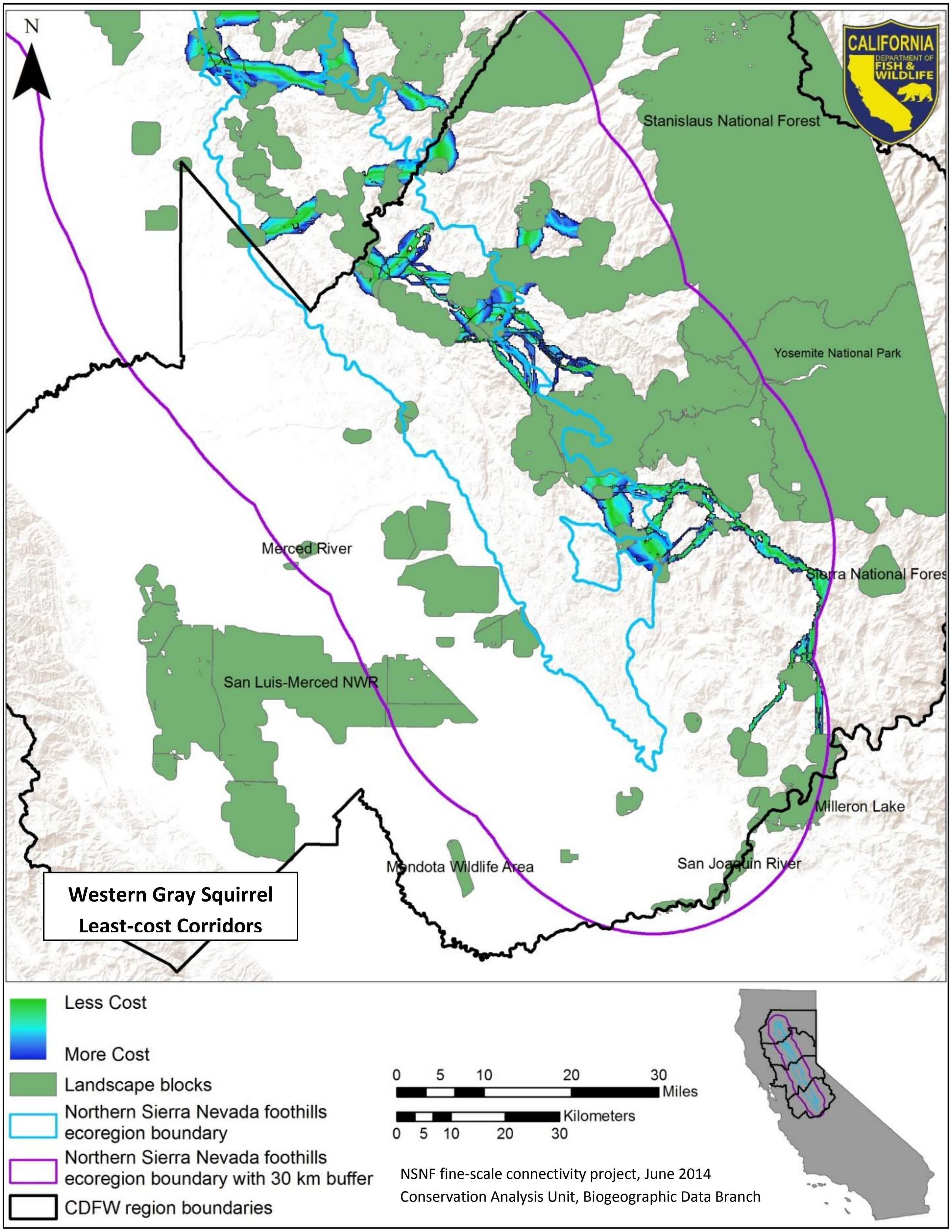


Figure S-127. Least-cost corridor analysis for the western gray squirrel (*Sciurus griseus*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Western pond turtle (*Actinemys marmorata*)

Focal species selection: Western pond turtles are uncommon to common in suitable aquatic habitat throughout California, west of the Sierra-Cascade crest. They are absent from desert regions, except in the Mojave Desert along the Mojave River and its tributaries (CWHR 2008). The elevation range of the species extends from near sea level to 1430 m (Jennings and Hayes 1994). Western pond turtle are **habitat specialists** associated with permanent or nearly permanent water in a wide variety of habitat types (CWHR 2008). Storer (1930) suggested that two distinct habitats may be used for oviposition; along large slow-moving streams, eggs are deposited in nests constructed in sandy banks; along foothill streams, females may climb hillsides, sometimes moving considerable distances to find a suitable nest site.

Habitat Model: The final three habitat suitability models developed for western pond turtle were the expert opinion CWHR Bioview, and Maxent scenarios 7w and 9w. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 1032 location points to train each model, 258 to test each model, and 9725 background points. Environmental variables for the Maxent scenario 7w model included elevation, distance to water, and vegetation represented by five continuous variables (percent wetland, percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9w model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by five continuous variables.

Patch Analysis: Territory/Home Range: Western pond turtle home range is normally quite restricted except for occasional long distance movement for egg-laying. Minimum breeding patch size used was 1 ha; minimum population patch size was 25 ha.

Dispersal/Migration: During spring or early summer, females move overland for up to 100 m to find suitable sites for egg-laying (CWHR 2008). Maximum dispersal distance used was 4 km.

Results and Discussion: The selected western pond turtle habitat suitability model was Maxent scenario 7w. The model performed well with an AUC of 0.94. The mean probability threshold was 0.14, predicting 2,468,627.3 ha of suitable habitat. The patch analysis identified 2,034 population patches covering 1,449,277.2 ha. We identified 84 western pond turtle least-cost corridors. Habitat patches covered 82.1% of the total corridor area. The corridors ranged in elevation from 7 m to 1,689 m. The least-cost corridors covered 367,815.2 ha of land, of those 23.5% were designated as GAP 1, 2 or 3 lands or in conservation easements, 76.5% are private lands. Western pond turtle corridors covered many different vegetation types: 31% of the total corridor area was in oak woodland, 23% in grassland, 13% in wetland and 12% in hardwood. Western pond turtle habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 37.2% of habitat area in the corridors had high predicted suitability, 20.7% medium and 42% low.

Potential habitat for western pond turtle is limited to riparian areas across of the study area.

Region 1: Habitat is limited to riparian areas in the northern region of the study area. Connectivity is limited to between the Chilcoot Wilderness Area – South Fork Battle Creek – Battle Creek blocks and Chilcoot Wilderness Area – Stillwater Plains – Cow Creek –Shasta Lake blocks. Seven of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 North: Habitat patches on the western side near the Sacramento River NWR, Gray Lodge WMA and Sutter Bypass blocks are isolated from the main foothills blocks except for one corridor. Twenty-one of the corridors are in this region of the study area and capture most of the habitat patches.

Region 2 South: Habitat patches on the western side near the American Basin and Pleasant Grove Creek blocks are isolated from the main foothill blocks. Habitat patches in the foothills and eastern side of the study area are fairly continuous. Forty-five of the corridors are in this region of the study area and capture most of the habitat patches.

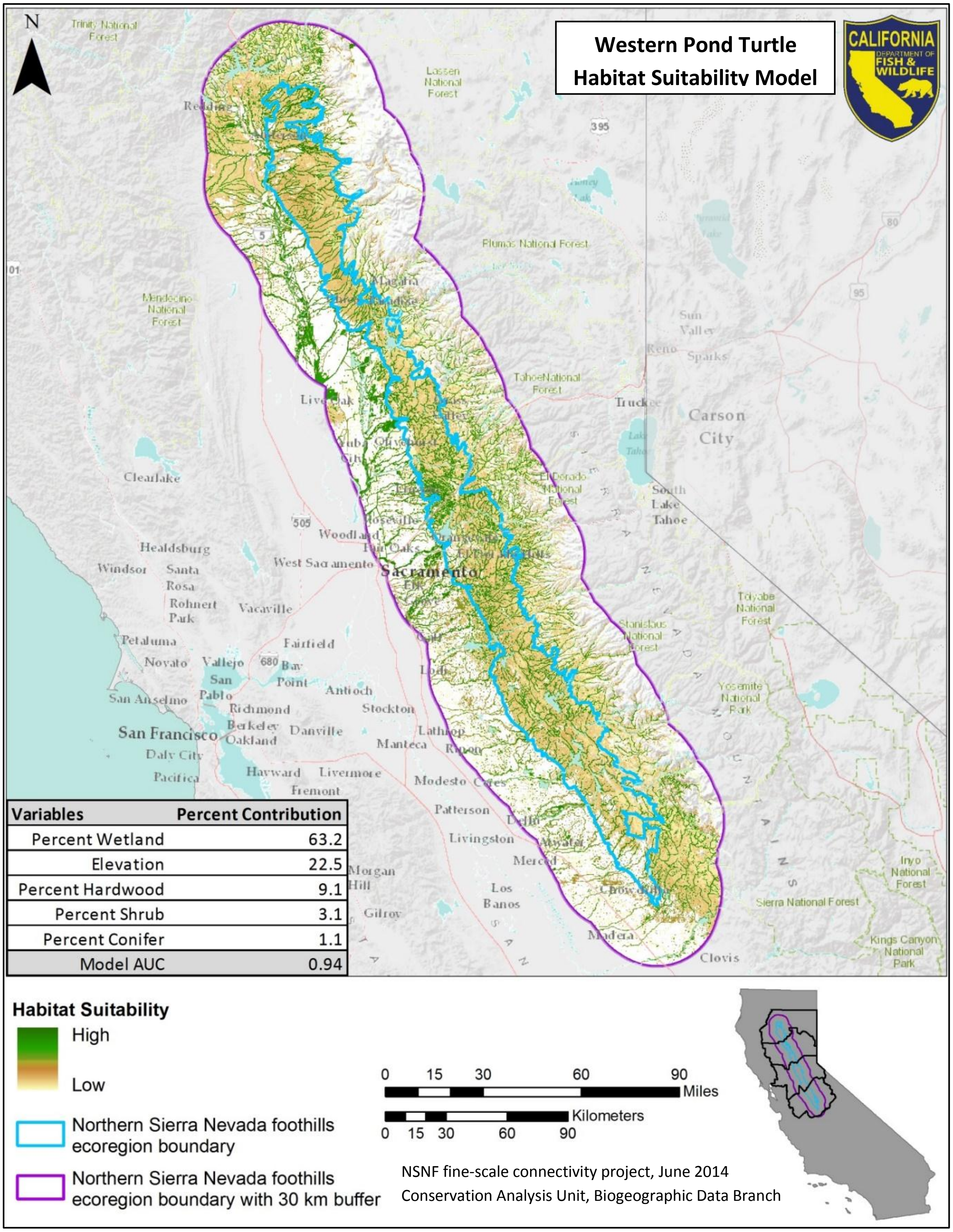
Region 4: Habitat patches on the western side near the Merced River and San Luis-Merced NWR blocks are isolated from foothill blocks of Black Rascal Creek and San Luis NWR. Twenty-five of the corridors are in this region of the study area and capture most of the habitat patches.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.94	0.14	2,468,627.3	1,449,277.2	2,034

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
67	17.9	15.0

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
84	82.1	42.0	20.7	37.2

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
8.6	15.8	33.9	13.7



Variables	Percent Contribution
Percent Wetland	63.2
Elevation	22.5
Percent Hardwood	9.1
Percent Shrub	3.1
Percent Conifer	1.1
Model AUC	0.94

Figure S-128. Predicted habitat suitability for the western pond turtle (*Actinemys marmorata*). Environmental variables for the Maxent scenario 7w model included elevation, distance to water, and vegetation represented by five continuous variables (percent wetland, percent conifer, percent grassland, percent hardwood and percent shrub).

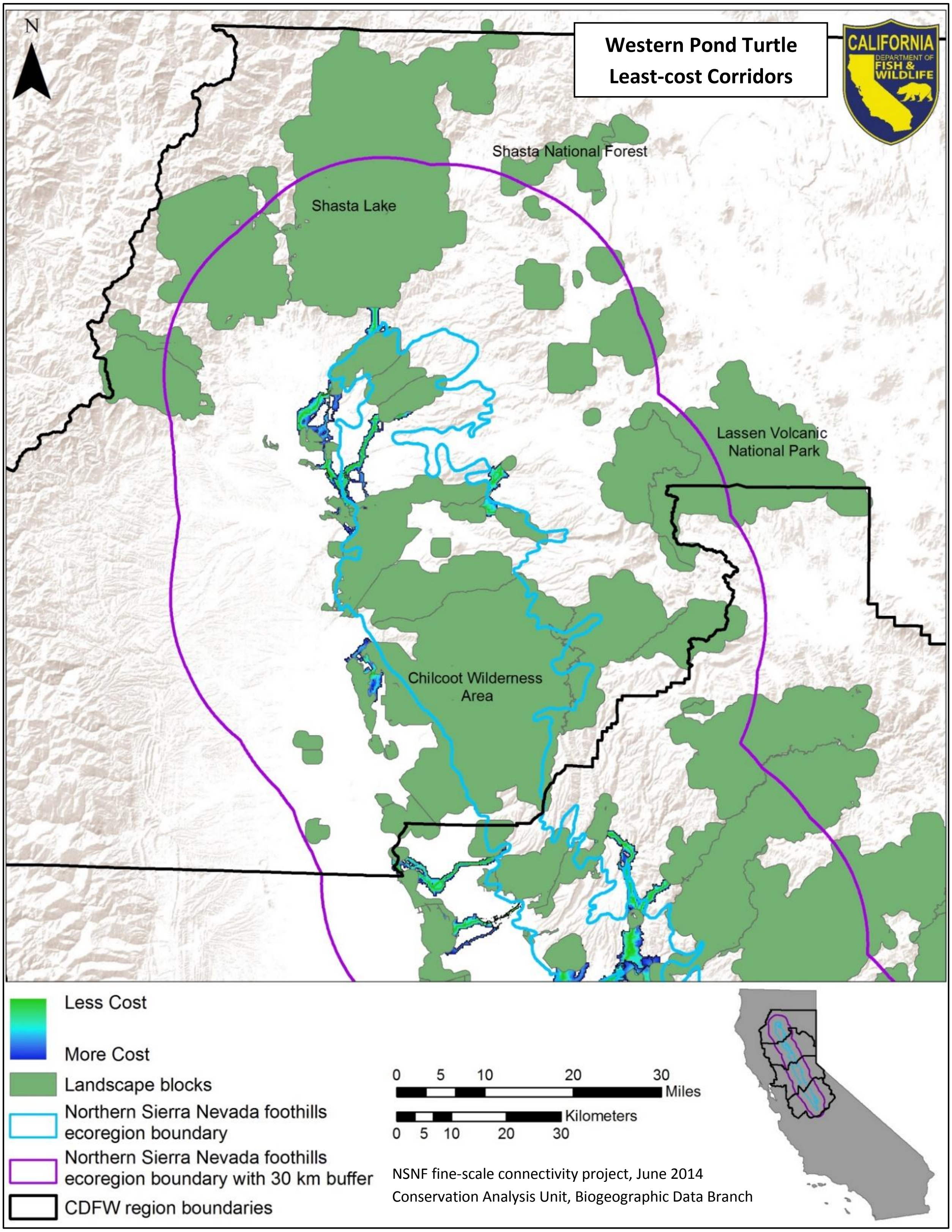


Figure S-129. Least-cost corridor analysis for the western pond turtle (*Actinemys marmorata*), northern Sierra Nevada foothills, CDFW Region 1 subsection.

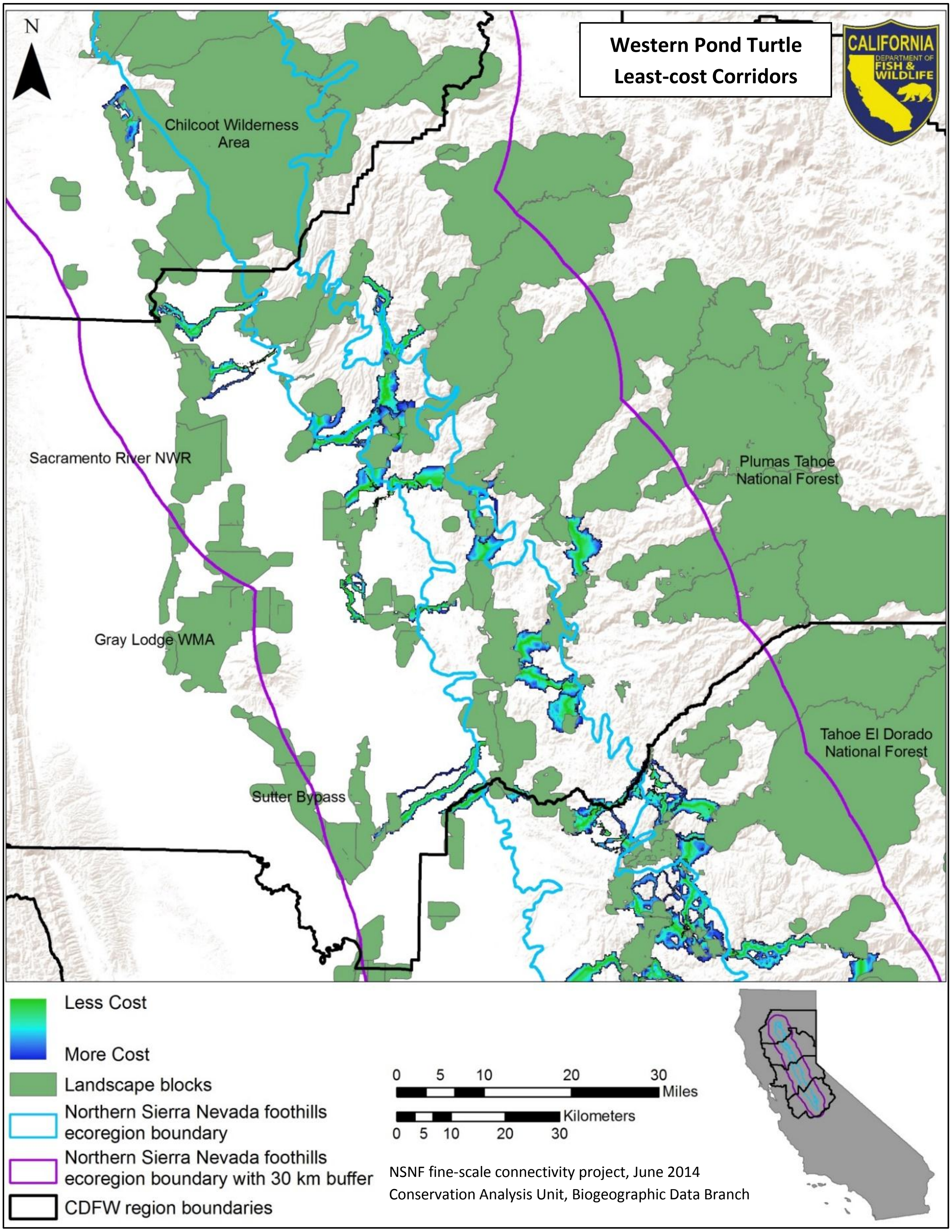


Figure S-130. Least-cost corridor analysis for the western pond turtle (*Actinemys marmorata*), northern Sierra Nevada foothills, CDFW Region 2 North subsection.

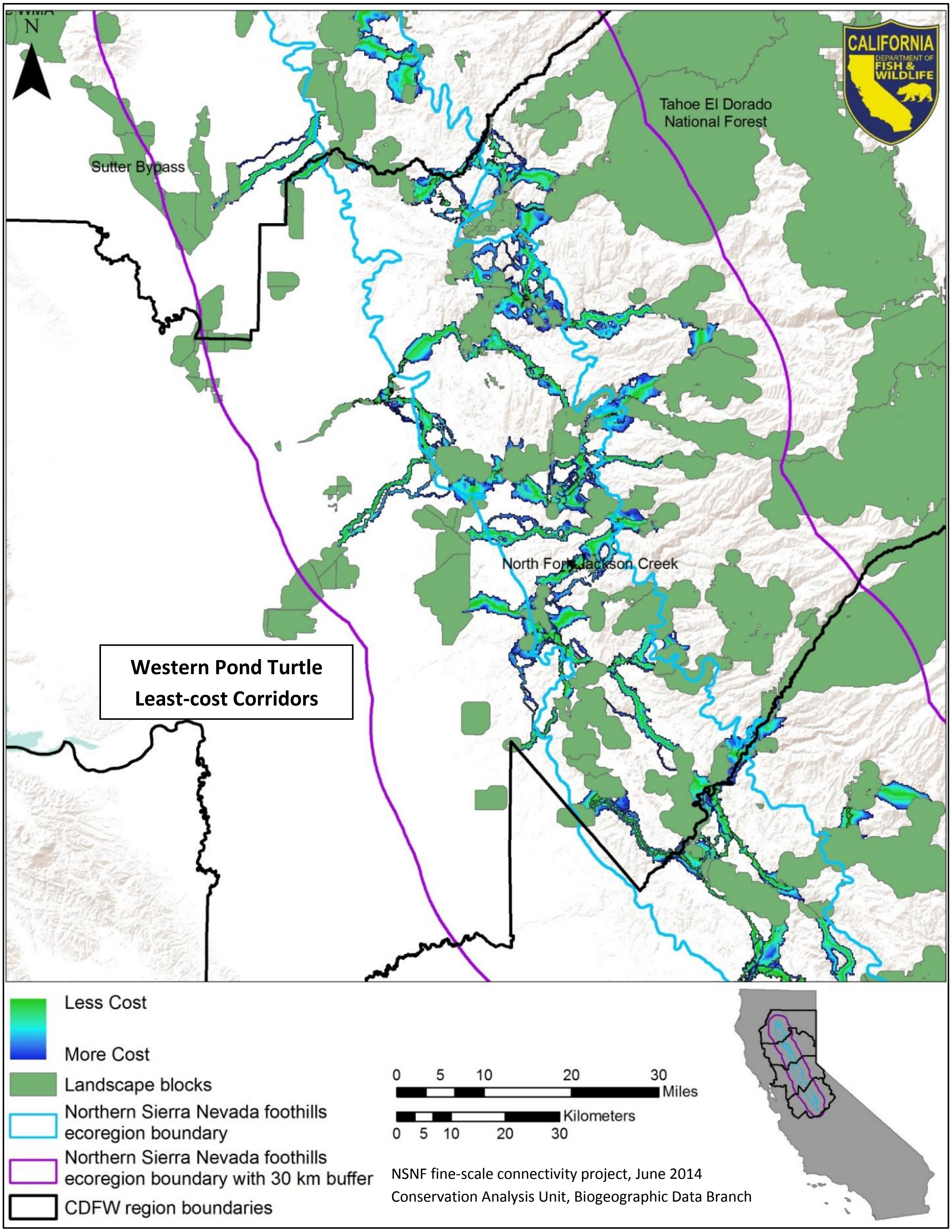


Figure S-131. Least-cost corridor analysis for the western pond turtle (*Actinemys marmorata*), northern Sierra Nevada foothills, CDFW Region 2 South subsection.

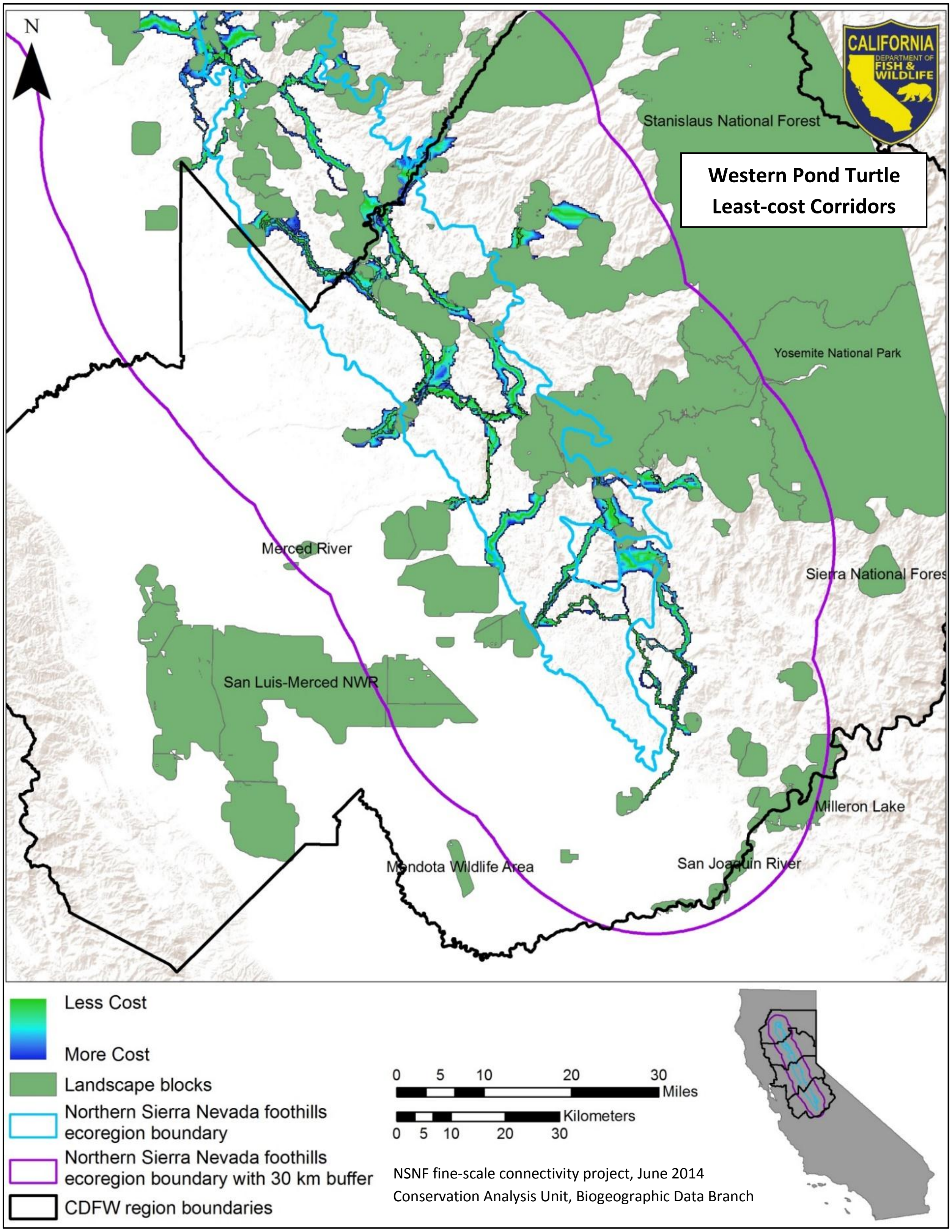
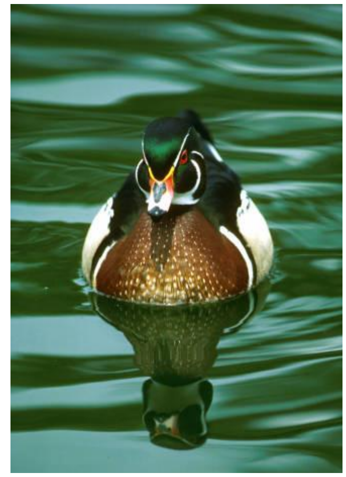


Figure S-132. Least-cost corridor analysis for the western pond turtle (*Actinemys marmorata*), northern Sierra Nevada foothills, CDFW Region 4 subsection.

Wood duck (*Aix sponsa*)



Focal species selection: Wood ducks are uncommon yearlong residents, mainly occurring in the Central Valley and Coast Ranges of central California. Wood ducks inhabit lacustrine and slow-moving riverine habitats bordered by trees or other tall vegetation and preferably by emergent vegetation as well. The species prefers aquatic habitats bordered by deciduous trees such as willows, cottonwoods and oaks (Grinnell and Miller 1944). For nesting, wood ducks require trees bordering a quiet aquatic habitat with emergent vegetation; in the nonbreeding season, an aquatic habitat may be bordered by any tall vegetation but trees are preferred (CWHR 2008). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the wood duck was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for wood duck were the expert opinion CWHR Bioview, and Maxent scenarios 5w and 6w. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 1320 location points to train each model, 331 to test each model, and 9653 background points. Environmental variables for the Maxent scenario 5w model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, and percent wetland. Environmental variables for the Maxent scenario 6w model included elevation, percent wetland, and a 15 class vegetation layer.

Patch Analysis: Territory/Home Range: Summer home ranges of flightless broods in Ohio were 0-5.6 km along a river and 0-12.8 km for fledged broods (Stewart 1958). Home ranges of breeding males in Minnesota averaged 202 ha and those of unpaired males were 526 ha (Gilmer 1971). Minimum breeding patch size used was 12 ha; minimum population patch size was 370 ha.

Dispersal/Migration: The species is non-migratory over most of its California range, but breeding populations east of the Sierra Nevada and Cascades are absent in fall and winter and a sparse wintering population in southern California is mostly absent April to August. Some populations shift from higher to lower elevation in winter (Naylor 1960). The maximum dispersal distance used was 1.6 km (Hepp and Bellrose 2013).

Results and Discussion: The selected wood duck habitat suitability model was Maxent scenario 6. The model performed well with an AUC of 0.95. The mean probability threshold was 0.17 predicting 1,054,068 ha of suitable habitat. The patch analysis identified 316 breeding patches covering 25,594.3 ha and 155 population patches covering 1,487,067.7 ha. One hundred thirty-four of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 65.9% of the total corridor area. Wood duck habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 28.7% of habitat area in the corridors had high predicted suitability, 21.9% medium and 49.3% low.

Potential habitat for wood duck is limited to riparian areas across the study area.

Region 1: Habitat is limited to riparian areas in the northern region of the study area. Connectivity is limited to between the Chilcoot Wilderness Area and Whisheytown-Shasta-Trinity NRA block, Shasta Lake and Lassen Volcanic NP.

Region 2 North: Habitat is limited to the foothills in this region with only scattered patches on the eastern and western sides of the study area. Habitat patches on the western side near the Sacramento River NWR, Gray Lodge WMA and Sutter Bypass blocks are isolated from the main foothills blocks except for one connection. Connectivity between the Chiloot WA and Plumas-Tahoe NF is also limited. Habitat patches in the foothills are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited in this region. Habitat patches on the western side near the Cosumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Region 4: Habitat is limited in this region with only scattered patches throughout the study area. Habitat patches on the western side near the Merced River block are isolated from foothill blocks of Black Rascal Creek and San Luis NWR.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.95	0.17	105,4068.4	1,513,464.0	581

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
55.7	21.2	23.1

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
134	65.9	49.3	21.9	28.7

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
34.7	40.4	48.6	39.1

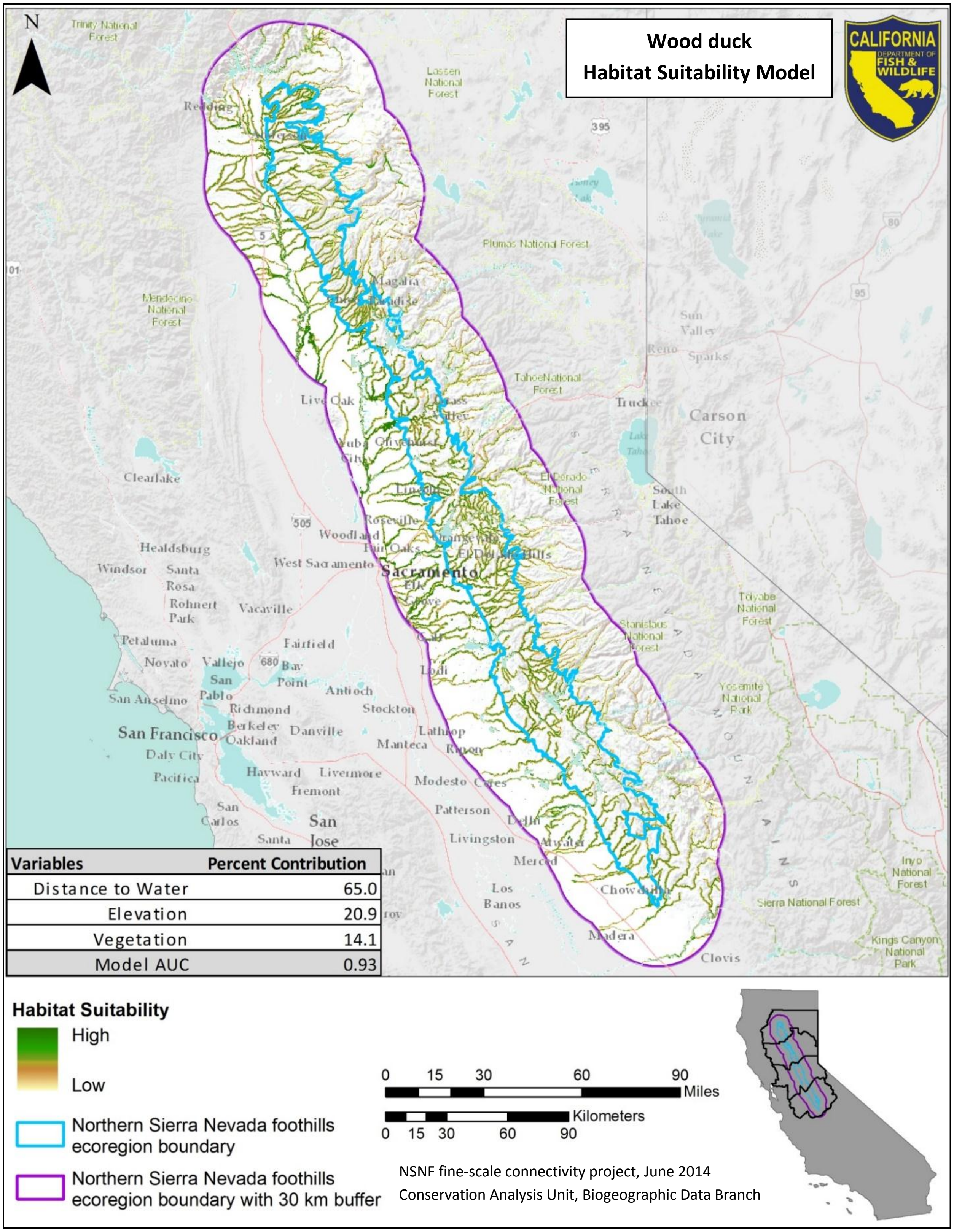


Figure S-133. Predicted habitat suitability for the wood duck (*Aix sponsa*). Environmental variables for the Maxent scenario 6 model included elevation, distance to water, and a 15 class vegetation layer.

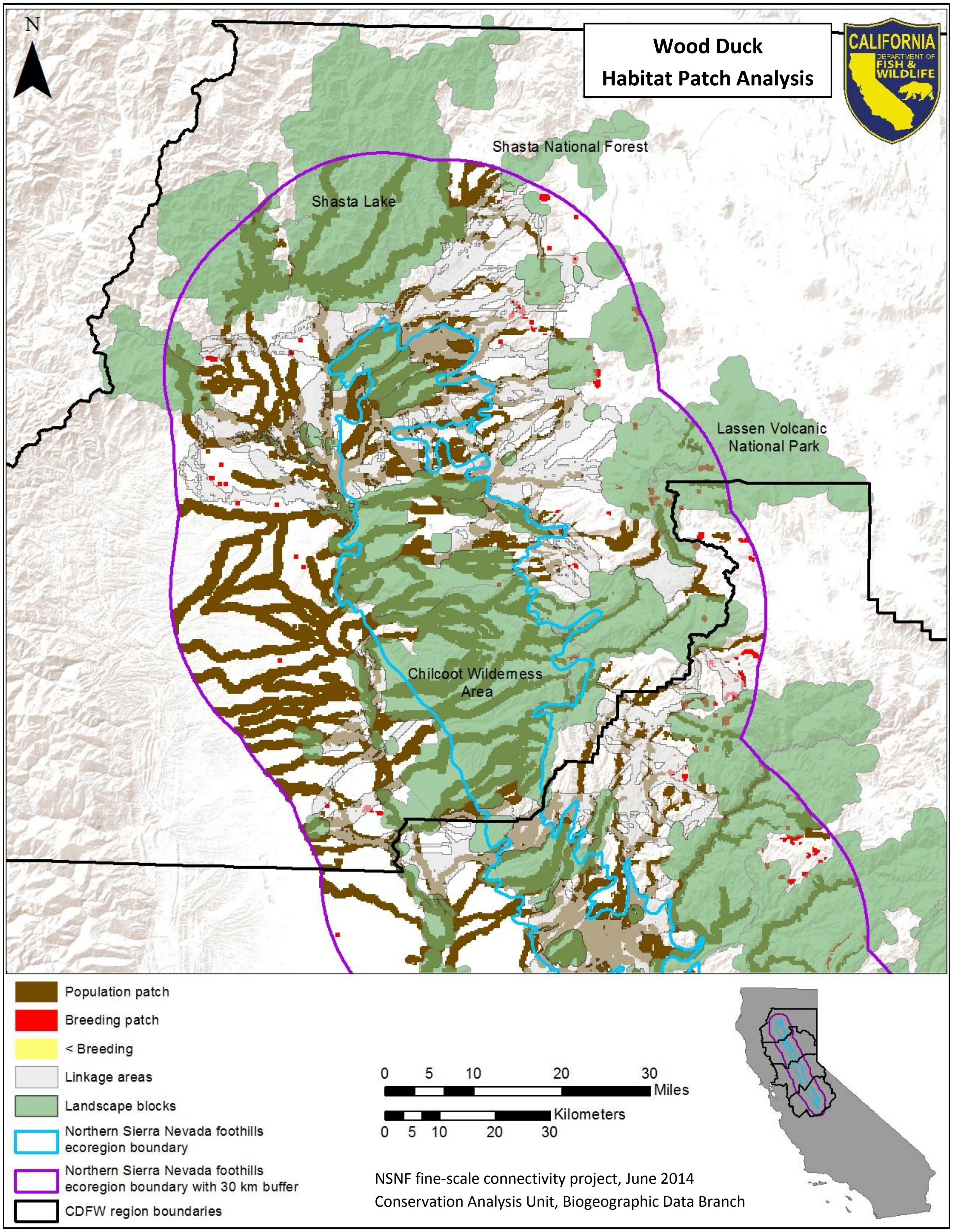


Figure S-134. Habitat patch analysis for the wood duck (*Aix sponsa*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

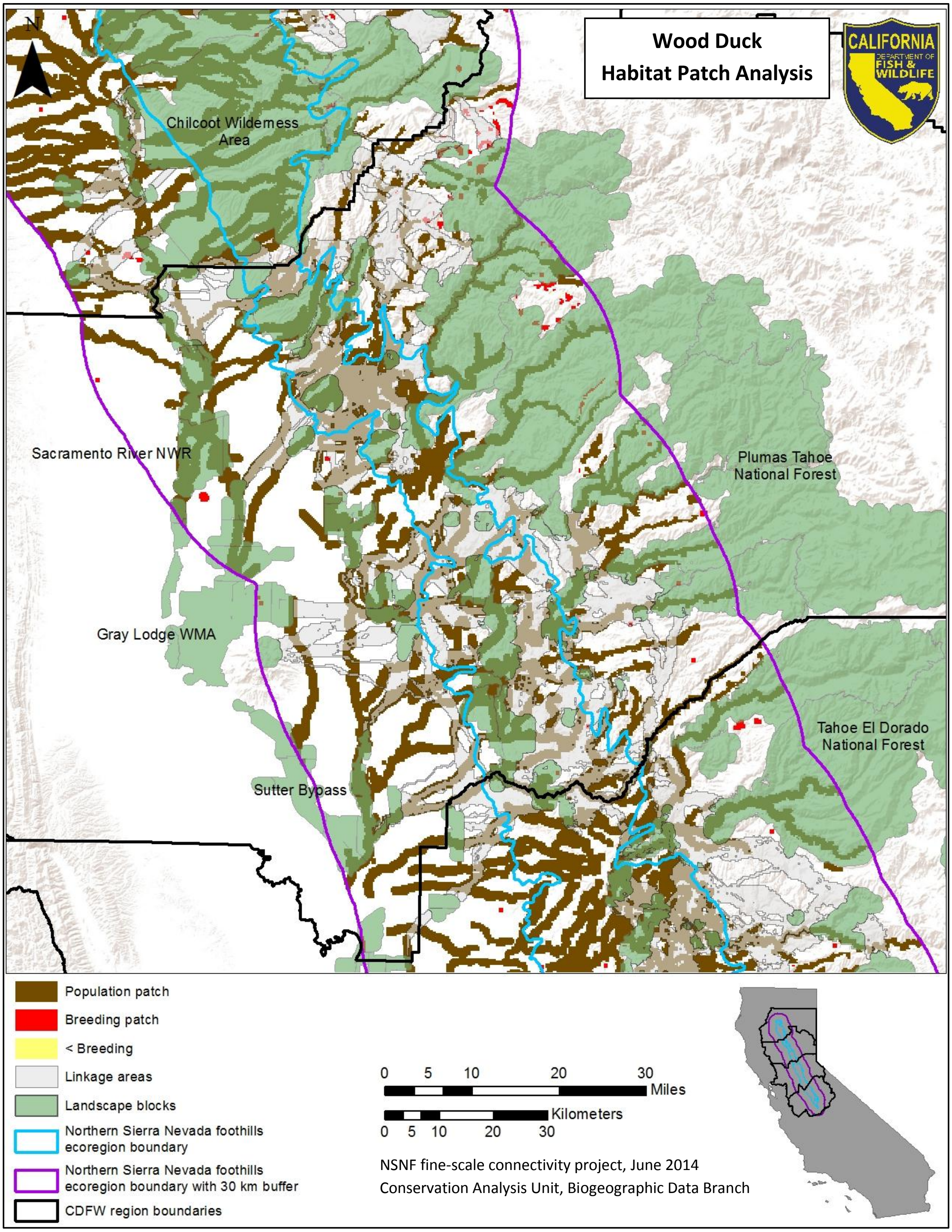


Figure S-135. Habitat patch analysis for the wood duck (*Aix sponsa*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

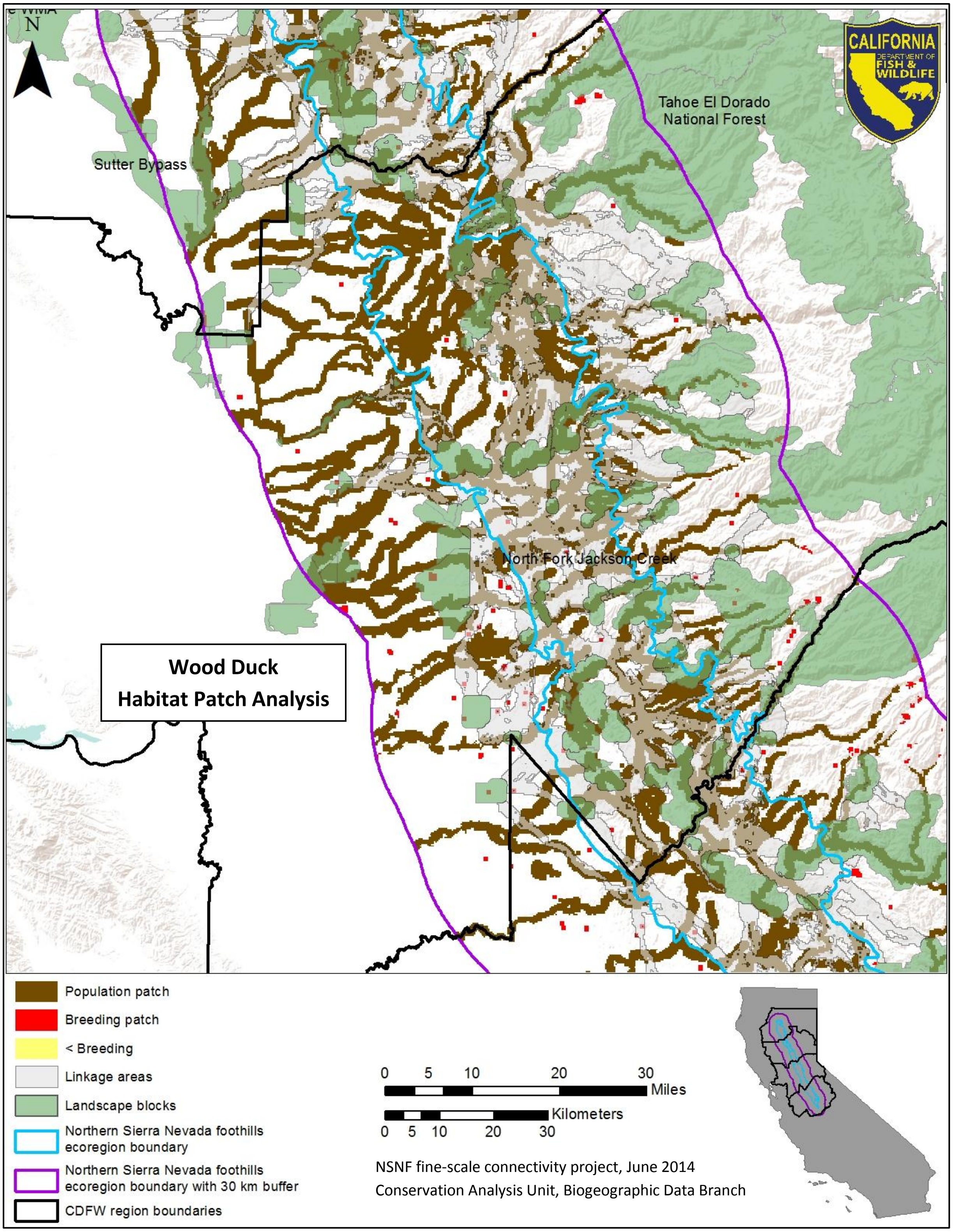


Figure S-136. Habitat patch analysis for the wood duck (*Aix sponsa*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

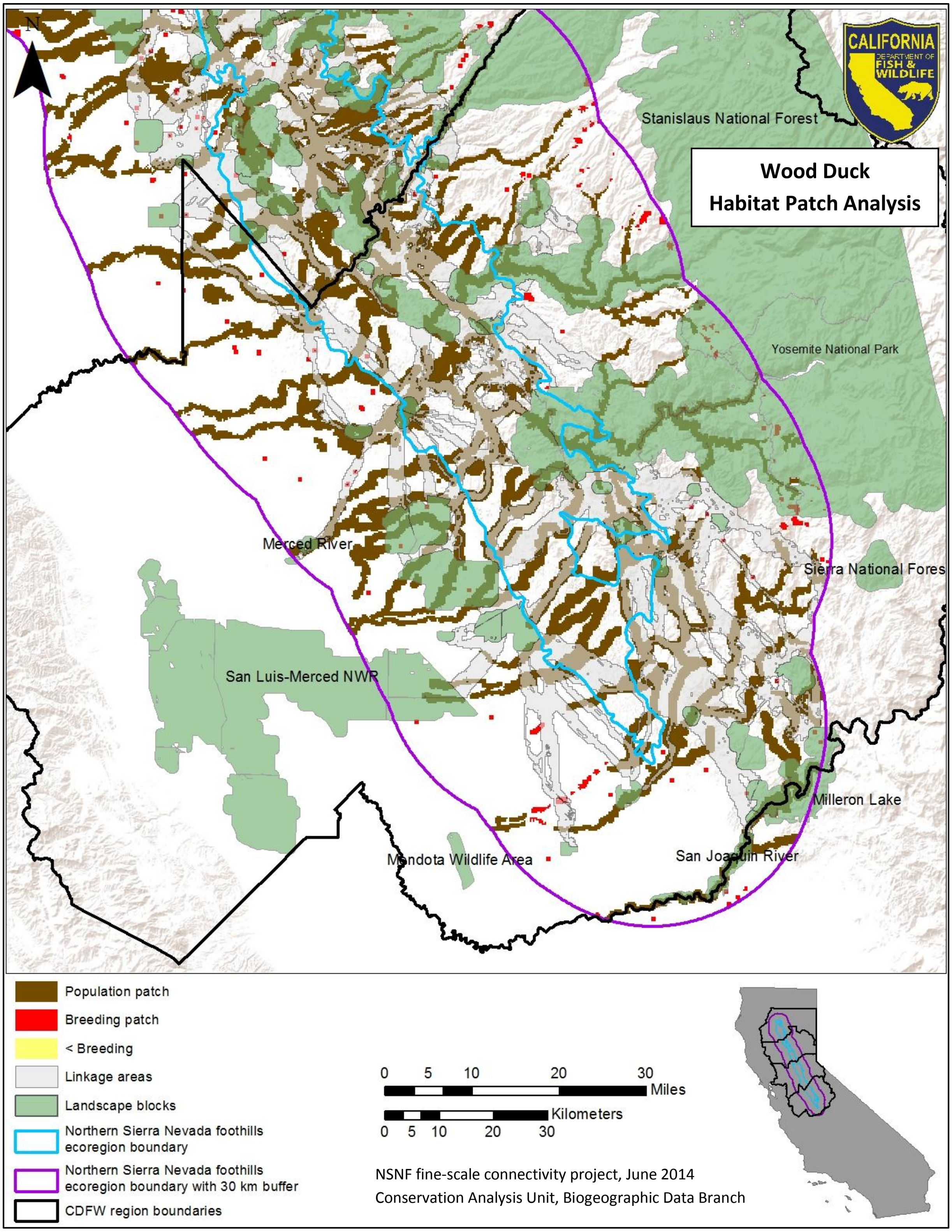


Figure S-137. Habitat patch analysis for the wood duck (*Aix sponsa*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

Yellow-billed magpie (*Pica nuttalli*)

Focal species selection: Yellow-billed magpies are common yearlong residents of the Central Valley and coastal mountain ranges south from San Francisco Bay to Santa Barbara County. Yellow-billed magpies inhabit valley foothill hardwood, valley foothill hardwood-conifer, valley foothill riparian, orchard, vineyard, cropland, pasture and urban habitats (CWHR 2008). The species prefers open oak and riparian woodland, farm, and ranchland with tall trees in the vicinity of grassland, pasture or crop land (Grinnell and Miller 1944). Yellow-billed magpies probably drink water (Grinnell and Miller 1944). Because of their ability to fly over barriers on the ground, least-cost corridors were not modeled for bird species. Therefore the yellow-billed magpie was included as a **corridor dweller**.

Habitat Model: The final three habitat suitability models developed for yellow-billed magpie were the expert opinion CWHR Bioview, and Maxent scenarios 7 and 9. The CWHR Bioview model was defined from vegetation, size and density for 63 vegetation classes. For the two Maxent scenarios we used 3129 location points to train each model, 783 to test each model, and 9202 background points. Environmental variables for the Maxent scenario 7 model included elevation, distance to water, and vegetation represented by four continuous variables (percent conifer, percent grassland, percent hardwood and percent shrub). Environmental variables for the Maxent scenario 9 model included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

Patch Analysis: Territory/Home Range: Verbeek (1973) reported that home range in Monterey County averaged about 40 ha during the breeding season and expanded to about 607 ha in nonbreeding season. Minimum breeding patch size used was 22 ha; minimum population patch size was 550 ha.

Dispersal/Migration: The species is non-migratory. Maximum dispersal distance used was 1.2 km (Koenig and Reynolds 2009).

Results and Discussion: The selected yellow-billed magpie habitat suitability model was Maxent scenario 9. The model performed well with an AUC of 0.89. The mean probability threshold was 0.14 predicting 3,750,355.1 ha of suitable habitat. The patch analysis identified 140 breeding patches covering 13,092.1 ha and 23 population patches covering 2,348,988.7 ha. One hundred fifty-seven of the least-cost union corridors were identified to have suitable habitat patches within the maximum dispersal distance and were included in the final linkages. Habitat patches covered 91.4% of the total corridor area. Yellow-billed magpie predicted habitat was categorized as low (threshold-50), medium (50-75) or high (75-100) based on predicted suitability; 21.7% of habitat area in the corridors had high predicted suitability, 44.6% medium and 33.8% low.

Potential habitat for yellow-billed magpie is widespread throughout the foothills and western side of the study area.

Region 1: Most habitat patches are continuous on the western side of Chilcoot WA block. All landscape blocks with habitat patches, including Chilcoot WA, Cow Creek, McClure, and Brannin Creek blocks, were connected with continuous habitat patches.

Region 2 North: Habitat is limited to the foothills and western side in this region of the study area. Habitat patches in the foothills and western side of the study area are fairly continuous and are captured by most linkages.

Region 2 South: Habitat is limited to the foothills and western side in this region of the study area. Habitat patches on the western side near the Cosumnes River Ecological Reserve are isolated from foothill blocks such as Deer Creek Hills and Crevis Creek. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

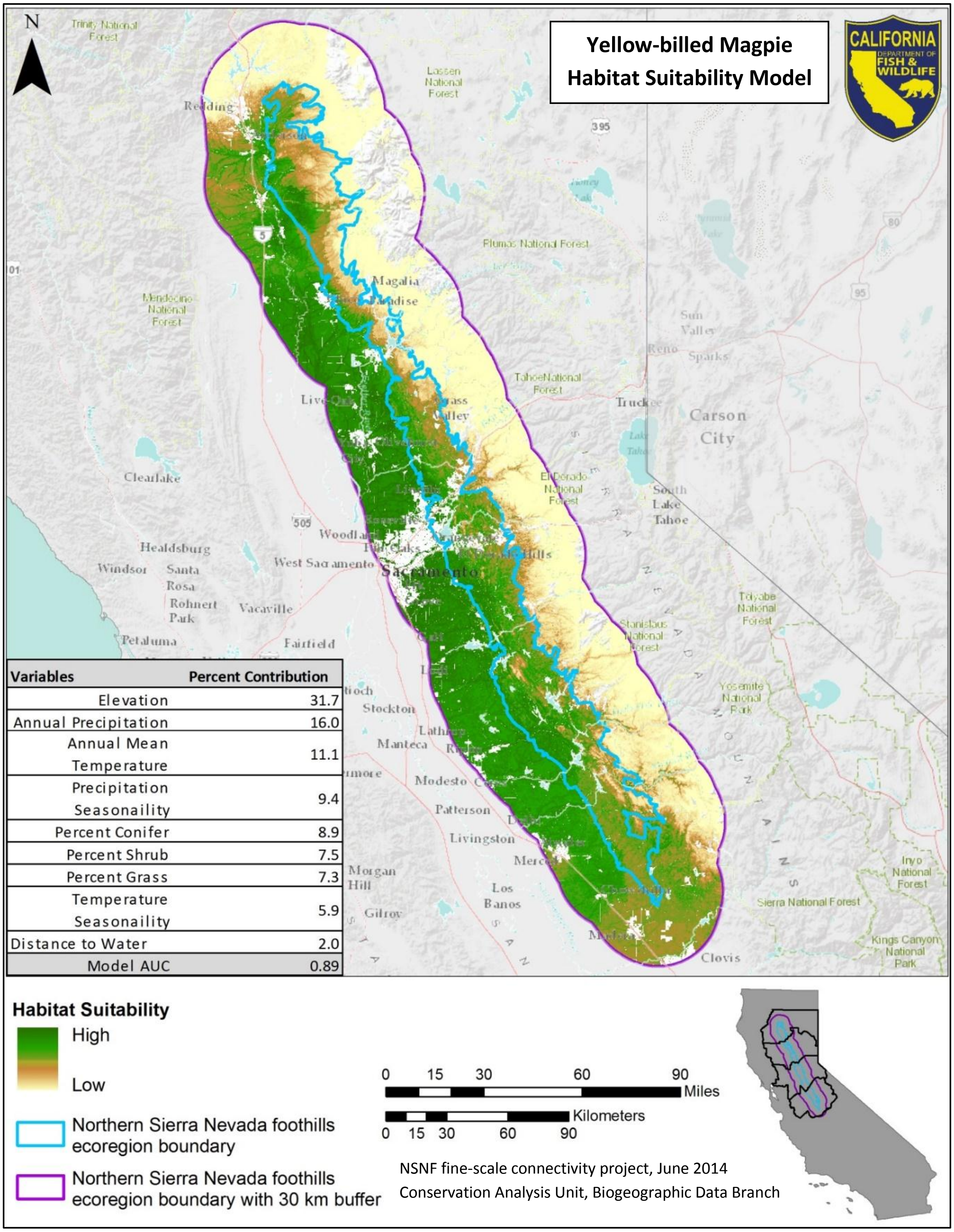
Region 4: Habitat is limited to the foothills and western side in this region with only scattered patches on the eastern side of the study area. Habitat patches on the eastern side near the Airway Beacon block are isolated from surrounding blocks. Habitat patches in the foothills and eastern side of the study area are fairly continuous and are captured by most linkages.

Maxent model AUC	Maxent model threshold	Total predicted habitat (ha)	Total area of patch habitat (ha)	Number of habitat patches
0.89	0.14	3750355.1	2362941.2	248

Percentage of total predicted habitat area with low suitability (threshold-50)	Percentage of total predicted habitat area with med suitability (50.01-75)	Percentage of total predicted habitat area with high suitability (75.01-100)
55.8	27.6	16.5

Number of corridors	Percentage of total corridor area in habitat patches	Percentage of habitat area in corridors with low suitability	Percentage of habitat area in corridors with medium suitability	Percentage of habitat area in corridors with high suitability
157	91.4	33.8	44.6	21.7

Percentage of all low suitability habitat in corridors	Percentage of all med suitability habitat in corridors	Percentage of all high suitability habitat in corridors	Percentage of all suitable habitat in corridors
18.2	48.5	39.4	30.1



Variables	Percent Contribution
Elevation	31.7
Annual Precipitation	16.0
Annual Mean Temperature	11.1
Precipitation Seasonaility	9.4
Percent Conifer	8.9
Percent Shrub	7.5
Percent Grass	7.3
Temperature Seasonaility	5.9
Distance to Water	2.0
Model AUC	0.89

Figure S-138. Predicted habitat suitability for the yellow-billed magpie (*Pica nuttalli*). Environmental variables for the Maxent scenario 9 included four bioclimatic variables (annual mean temperature, temperature seasonality, annual precipitation and precipitation seasonality), elevation, distance to water, and vegetation represented by four continuous variables.

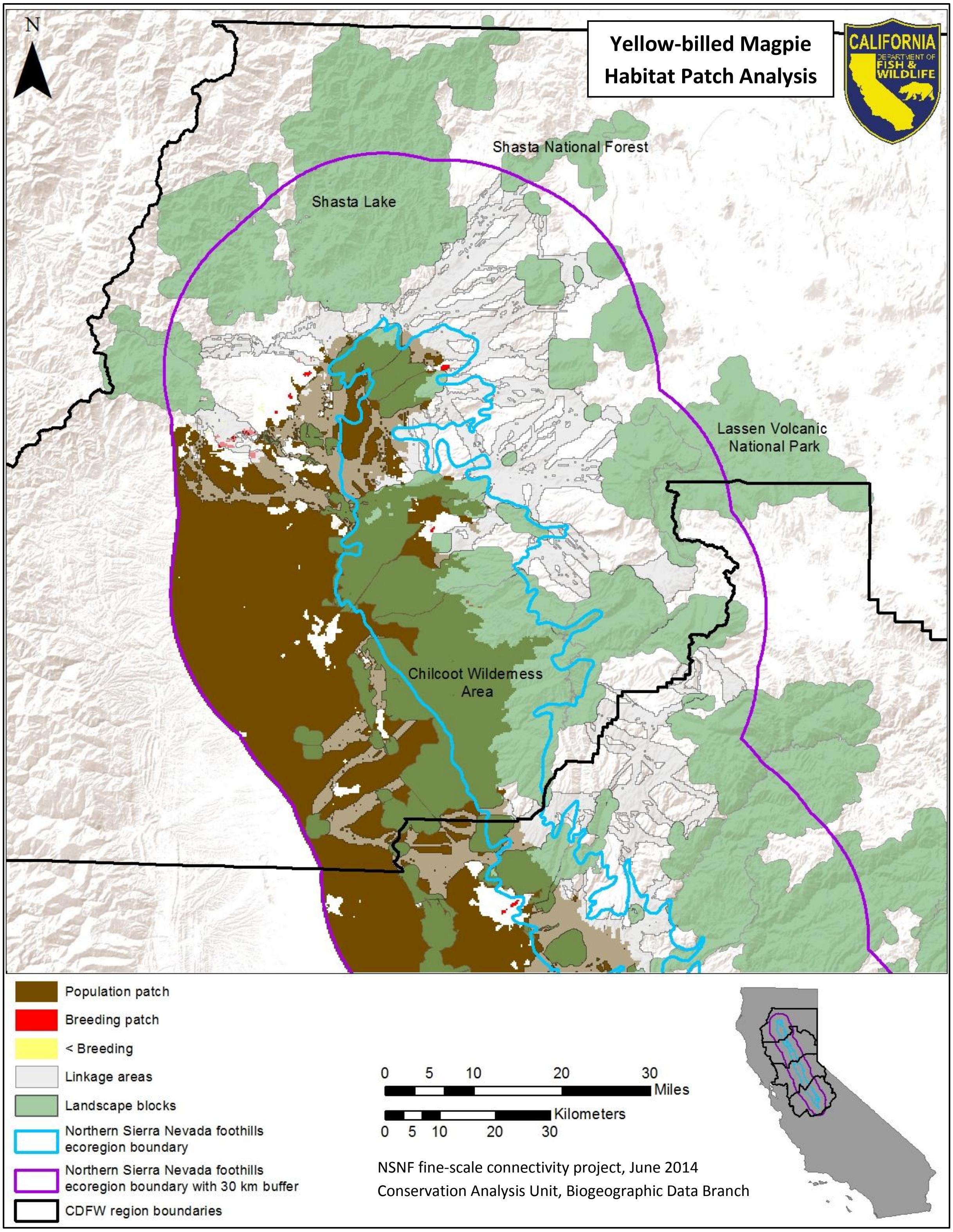


Figure S-139. Habitat patch analysis for the yellow-billed magpie (*Pica nuttalli*), northern Sierra Nevada foothills, CDFW Region 1 subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

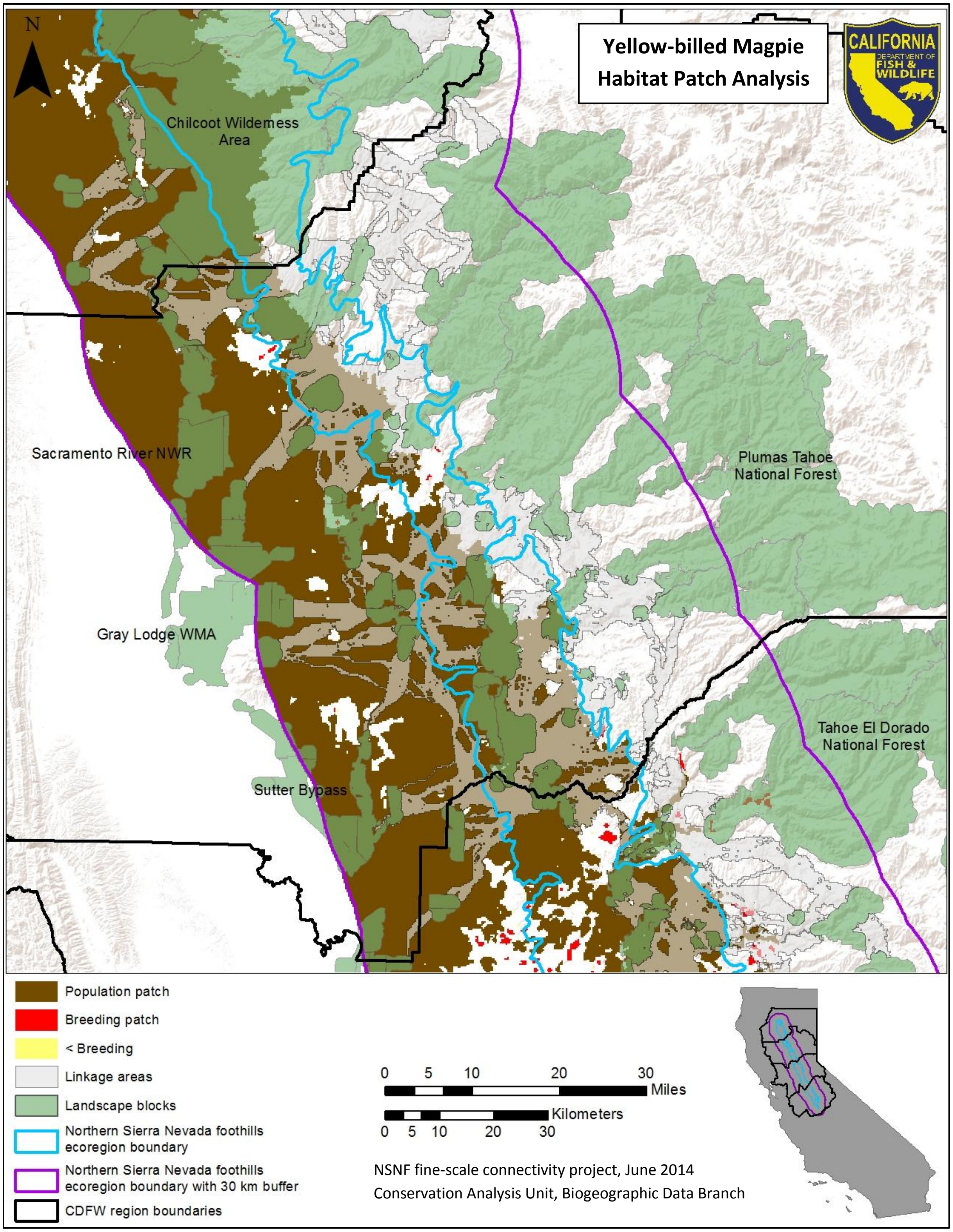


Figure S-140. Habitat patch analysis for the yellow-billed magpie (*Pica nuttalli*), northern Sierra Nevada foothills, CDFW Region 2 North subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

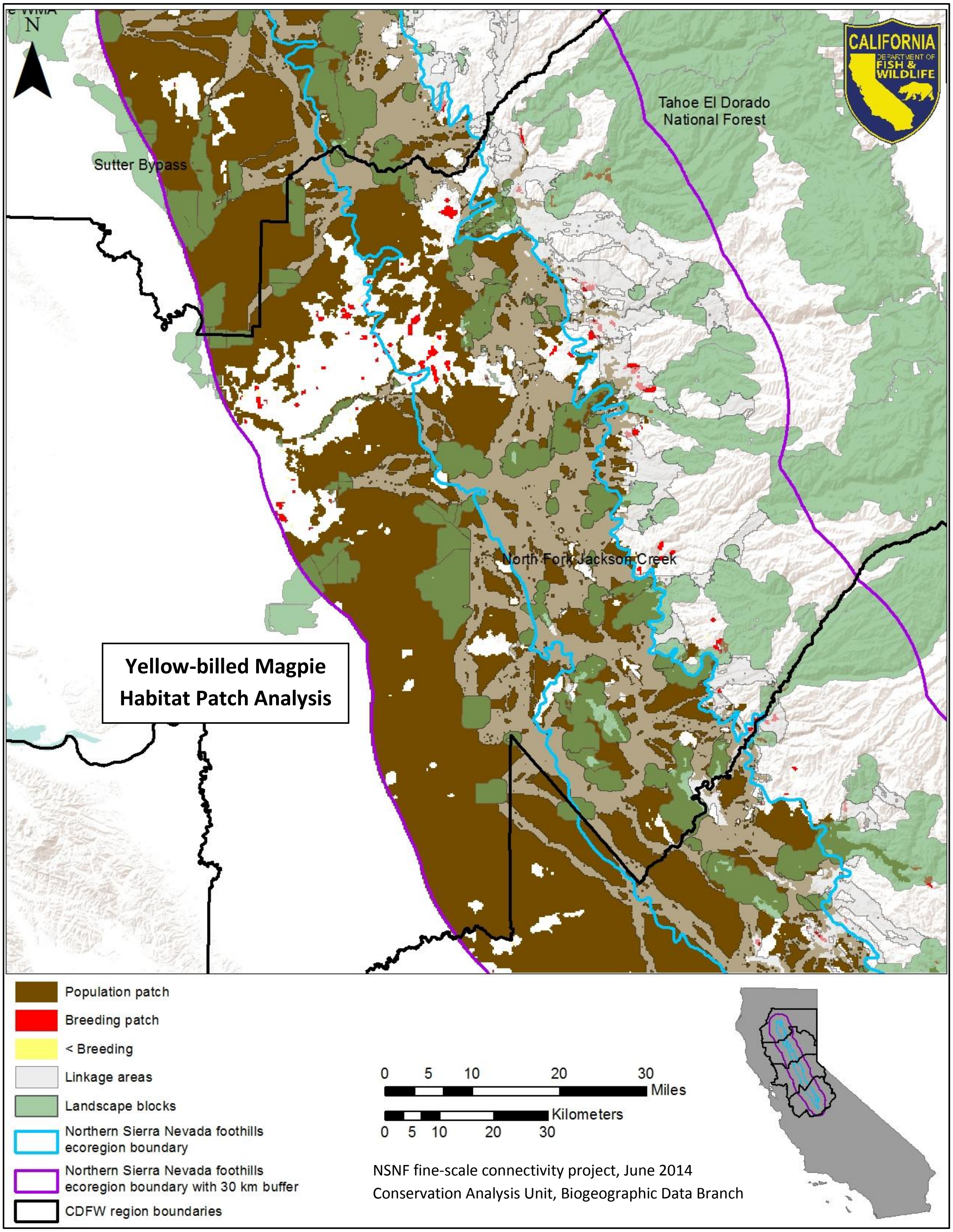


Figure S-141. Habitat patch analysis for the yellow-billed magpie (*Pica nuttalli*), northern Sierra Nevada foothills, CDFW Region 2 South subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

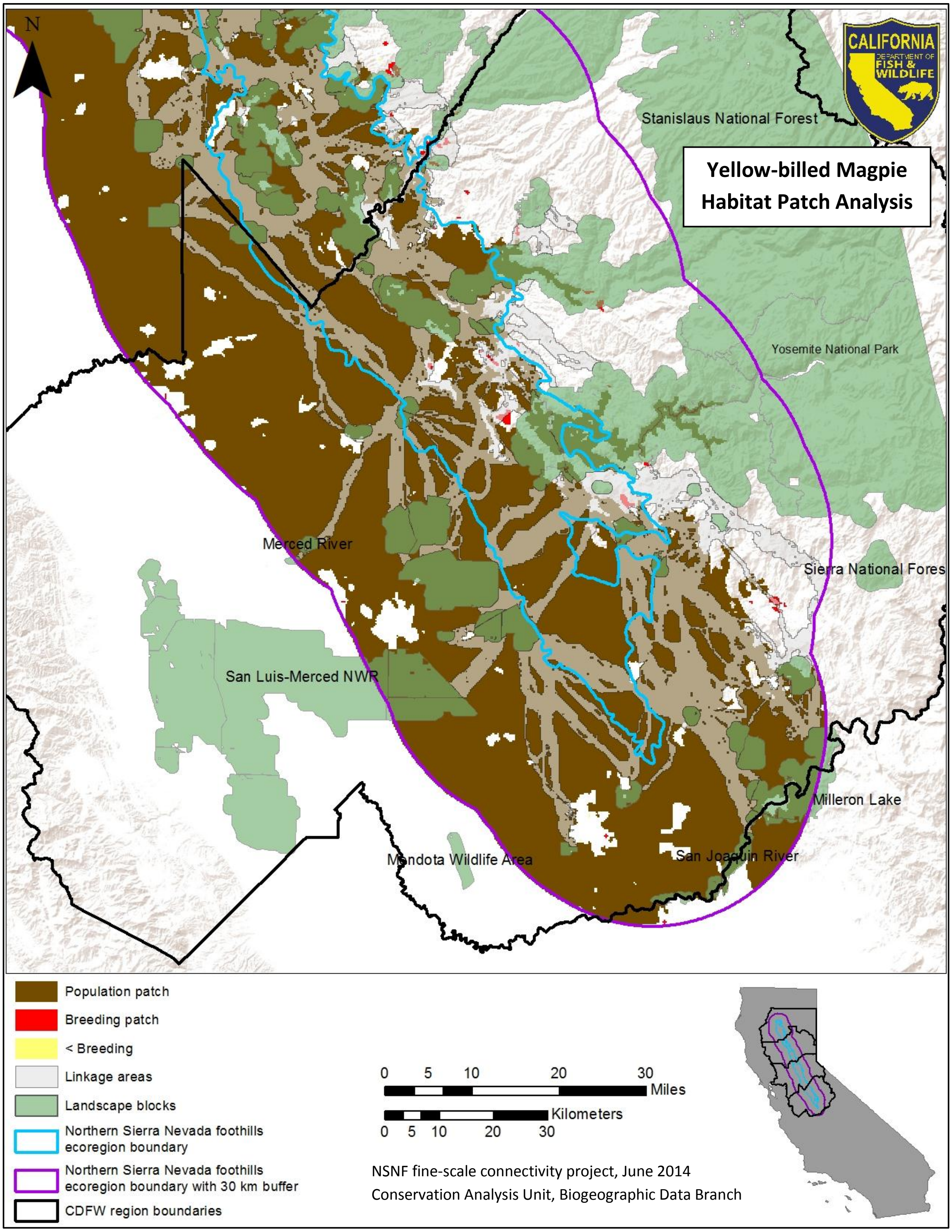


Figure S-142. Habitat patch analysis for the yellow-billed magpie (*Pica nuttalli*), northern Sierra Nevada foothills, CDFW Region 4 subsection. Population patches were defined as contiguous areas of suitable habitat >370 ha; breeding patches were contiguous areas of suitable habitat >12 ha.

Focal Species Literature Review

Bailey, T. N. (1974). "Social organization in a bobcat population." Journal of Wildlife Management **38**: 435-446.

Beier, P., K. Penrod, C. Luke, W. Spencer and C. Cabanero (2006). South Coast Missing Linkages: restoring connectivity to wildlands in the largest metropolian ara in the United States. Connecitivty Conservation. K. R. Crooks and M. A. Sanjayan. Cambridge, UK, Cambridge University Press.

Bleich, V. C. (1973). Ecology of rodents at the United States Naval Weapon Station, Seal Beach, Fallbrook Annex, San Diego County, California. MA, California State University.

Brown, E. R. (1961). The black-tailed deer of western Washington. Washington State Game Department Bulletin. **13:** 124.

Brown, W. S. and W. S. Parker (1976). "Movement ecology of Coluber constrictor near Communal Hibernacula." Copeia **1976**(2): 225-242.

CNDDB (2014). California Natural Diversity Database. Sacramento, California, California Department of Fish and Wildlife. **February 5, 2013**.

Cody, M. L. (2012). California thrasher (*Toxostoma redivivum*). The Birds of North America Online. A. Poole. Ithaca, Cornell Lab of Ornithology.

Craighead, J. J. and F. C. J. Craighead (1956). Hawks, owls and wildlife. Harrisburg, PA, Stackpole Books.

Cranford, J. A. (1977). "Home range and habitat utilization by Neotoma fuscipes as determined by radiotelemetry." Journal of Mammology **58**: 165-172.

Curtis, O. E., R. N. Rosenfield and J. Bielefeldt (2006). Cooper's Hawk (*Accipiter cooperii*). The Birds of North America. A. Poole. Ithaca, Cornell Lab of Ornithology.

CWHR (2008). California Wildlife Habitat Relationships. Sacramento, CA, California Department of Fish and Wildlife, California Interagency Wildlife Task Group. **8.2**.

Dawson, W. R. and J. R. Templeton (1966). "Physiological responses to temperature in the alligator lizard (*Gerrhontus mulicarinatus*)." Ecology **47**: 759-765.

Evans, F. C. and R. Holdenried (1943). "A population study of the Beechey ground squirrel in central California." Journal of Mammology **24**: 231-260.

Fitch, H. S. (1948). "Habits and economic relationships of the Tulare kangaroo rat." Journal of Mammology **29**: 5-35.

Fitch, H. S. (1958). Home ranges, territories and seasonal movements of vertebrates of the Natural History Reservation. Lawrence, KS USA, University of Kansas. **11:** 63-326.

Frye, G. G. and H. R. Jageman (2012). "Post-fledging ecology of Northern pygmy-owls in the Rocky Mountains." The Wilson Journal of Ornithology **124**(2): 199-207.

Fuller, T. K. (1978). "Variable home-range of female gray foxes." Journal of Mammology **59**(2): 446-449.

Gaines, D. (1974). "A new look at the nesting riparian avifauna of the Sacramento Valley, CA." Western Birds **5**: 61-80.

Garrett, K. and J. Dunn (1981). Birds of southern California, Los Angeles Audubon Society.

Geluso, K. N. (1978). "Urine concentrating ability and renal structure of insectivorous bats." Journal of Mammology **59**: 312-323.

Gilmer, D. S. (1971). Home range and habitat use of breeding mallards (Anas platyrhynchos) and wood ducks (Aix sponsa) in north-central Minnesota as determined by radio-tracking. PhD, University of Minnesota.

Grinnell, J. and A. H. Miller (1944). The distribution of birds of California. Pacific Coast Avifauna. **27:** 608.

Hepp, G. R. and F. C. Bellrose (2013). Wood Duck (*Aix sponsa*). The Birds of North America. A. Poole. Ithaca, Cornell Lab of Ornithology.

Ingles, L. G. (1965). Mammals of the Pacific states. Stanford, CA, Stanford University Press.

Jennings, M. R. (1996). Status of Amphibians. Sierra Nevada Ecosystems Project, Assessments and Scientific Basis for Management Options, Final Report to Congress, vol. II. Davis, CA, University of California, Centers for Water and Wildland Resources. **2**.

Jennings, M. R. and M. P. Hayes (1994). Amphibian and reptile species of specieal concern in California. Rancho Cordova, CA, Calfiornia Department of Fish and Game**:** 255.

Kingery, H. E. (1978). Coastal chaparral. Twenty-sixth breeding bird census. G. A. Hall. Audubon Field Notes. **16:** 518-540.

Koenig, W. and M. D. Reynolds (2009). Yellow-billed Magpie (*Pica nuttalli*). The Birds of North America. A. Poole. Ithaca, Cornell Lab of Ornithology.

Koenig, W., P. B. Stacey, M. T. Stanback and R. L. Mumme (1995). Acorn Woodpecker (*Melanerpes formicivorus*). The Birds of North America. A. Poole. Ithaca, Cornell Lab of Ornithology.

Lechleitner, R. R. (1958). "Movements, density and mortaility in a black-tailed jackrabbit population." Journal of Wildlife Management **22**: 371-384.

Lindsdale, J. M. and L. P. J. Tevis (1951). The dusky-footed woodrat. Berkeley, CA, University of California Press.

MacRoberts, M. H. and B. R. MacRobers (1976). "Social organization and behavior of the acorn woodpecker in central coastal California." Ornithology Monographs **21**: 115.

McCaskie, G., P. DeBenedictis, R. Erickson and J. Morlan (1979). Birds of northern California, an annotated field list. Berkeley, CA, Golden Gate Audubon Society.

Naylor, A. E. (1960). "The wood duck in California with special reference to the use of nest boxes." Calfiornia Fish and Game **46**: 241-270.

Parker, W. S. and W. S. Brown (1973). "Species composition and population changes in two complexes of snake hibernacula in northern Utah." Herpetologica **29**: 319-326.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, S. Loe and K. Meyer (2004). South Coast Missing Linkages Project: A Linkage Desing for the San Gabriel-San Bernardino Connection. Idyllwild, CA, South Coast Wildlands.

Penrod, K. C., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin and C. Paulman (2008). A linkage design for the Joshua Tree-Twentynine Palms Connection. Fair Oaks, CA, South Coast Wildlands.

RCIP (2000). Riverside Count Integrated Project, Western Riverside County MSHCP Species Accounts, Mammals.

Richardson, F. (1941). "Results of the southern California quail banding program." California Fish and Game(27): 234-249.

Rodriquez-Robles, J. A. (2003). "Home ranges of gopher snakes (*Pituophis catenifer*, Colubridae) in Central California." Copeia **2003**(2): 391-396.

Romin, L. A. and J. A. Bissonette (1996). "Deer: Vehicle Collisions: Status of State Monitoring Activities and Mitigation Efforts." Wildlife Society Bulletin **24**(2): 276-283.

Russell, K. R. (1978). Mountain Lion. Big game of North America. J. L. Schmidt and D. L. Gilbert. Harrisburg, PA, Stackpole Books**:** 207-225.

Soule, M. E., D. T. Bolger, A. C. Alberts, J. Wright, M. Sorice and S. Hill (1988). "Reconstructed Dynamics of Rapid Extinctions of Chaparral-Requiring Birds in Urban Habitat Islands." Conservation Biology **2**(1): 75-92.

Stebbins, R. C. (1985). A field guide to western reptiles and amphibians. Boston, MA, Houghton Mifflin.

Stewart, P. A. (1958). "Local movements of wood ducks (*Axis sponsa*)." Auk **75**: 157-168.

Storer, T. I., R. L. Usinger and D. Lukas (2004). Sierra Nevada Natural History. Berkeley and Los Angeles, CA, University of Califonia Press.

Taber, R. D. and R. F. Dasmann (1958). The black-tailed deer of the chaparral. Game Bulletin. Sacramento, CA, Califonia Department of Fish and Game. **8:** 163.

Tappe, D. T. (1941). "Natural history of Tulare kangaroo rat." Journal of Mammology **22**: 117-147.

Tordoff, W. I. (1980). Report of study of the limestone salamander on the Merced River, US Department of Interior, Buerau of Land Management. **CA-040-CTO-09**.

Van Vuren, D. (1998). Mammalian dispersal and reserve design. Behavioral ecology and conservation biology. T. M. Caro. New York, Oxford University Press**:** 369-393.

Verbeek, N. A. M. (1973). The exploitation system of the yellow-billed magpie. The birder's handbook. D. Wheye. New York, NY, Simon and Schuster**:** 1-58.

Verner, J. and A. S. Boss (1980). California wildlife and their habitats: western Sierra Nevada. General Technical Report PSW-37. Berkeley, CA, US Department of Agriculture, Forest Service**:** 439.

Yeaton, R. I. (1974). "An ecological analysis of chaparal and pine forest bird communities on Santa Cruz Island and mainland California." Ecology **55**: 959-973.

Zeiner, D. C., W. F. J. Laudenslayer, K. E. Mayer and M. White (1990). California's Wildlife. Sacramento, California, State of California, The Resources Agency, Department of Fish and Game.

Zezulak, D. S. and R. G. Schwab (1980). Bobcat biology in a Mojave Desert community. Sacramento, CA, California Department of Fish and Wildlife.

4.5 Wildlife Linkages

We created 246 linkages connecting 198 landscape blocks, from the corridor union incorporating 799 individual species habitat corridors. The corridor union covered 1,275,722.3 ha. Through the linkage analysis we deleted 231,346 ha and added 99,320.3 ha of corridor dweller habitat to complete the linkages. The total linkage area is 1,143,695.9 ha of land, of which, 13.9% are protected lands with GAP status 1, 2, or 3 or in a conservation easement (as mapped in NCED). The linkages range in elevation from 7 m to 2,379 m. The linkages covered many different vegetation types, for the total area of linkages 27.4% were in oak woodland, 24.6% in grassland, 5.5% in chaparral, and 10.6% in mixed conifer.

The linkage network connected species to protected lands throughout the foothills and surrounding ecoregions with each linkage providing habitat for at least seven species and up to 26 species. The mean number of species represented by the linkages was 16. All of the linkages represented at least four birds and up to 10 birds. All the linkages represented at least one mammal and up to 10 mammals. Two-hundred thirty-six of the corridors represented at least one amphibian or reptile and up to 7 amphibian or reptile species.

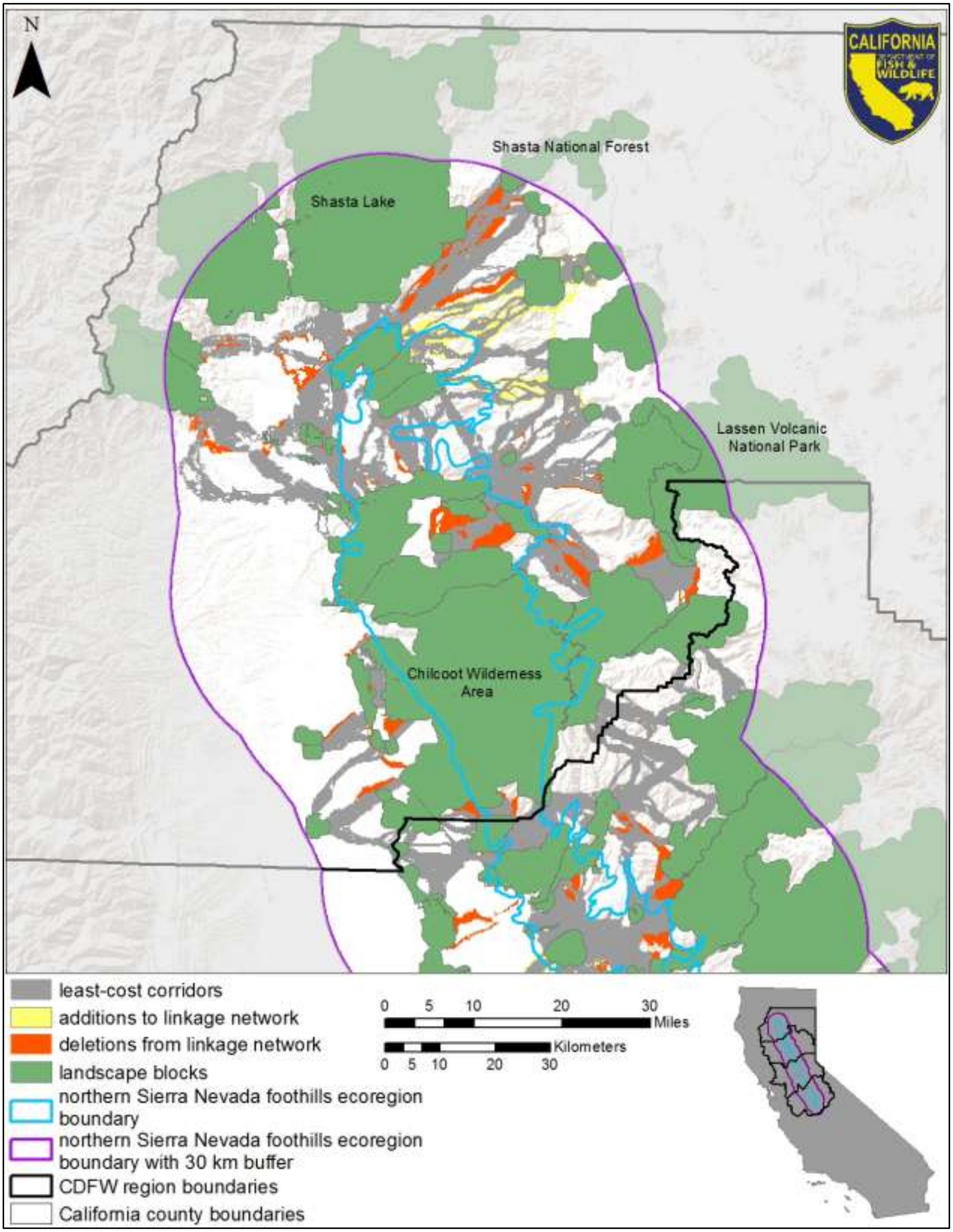


Figure 3. Final wildlife linkages showing additions and deletions. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 1 subsection.

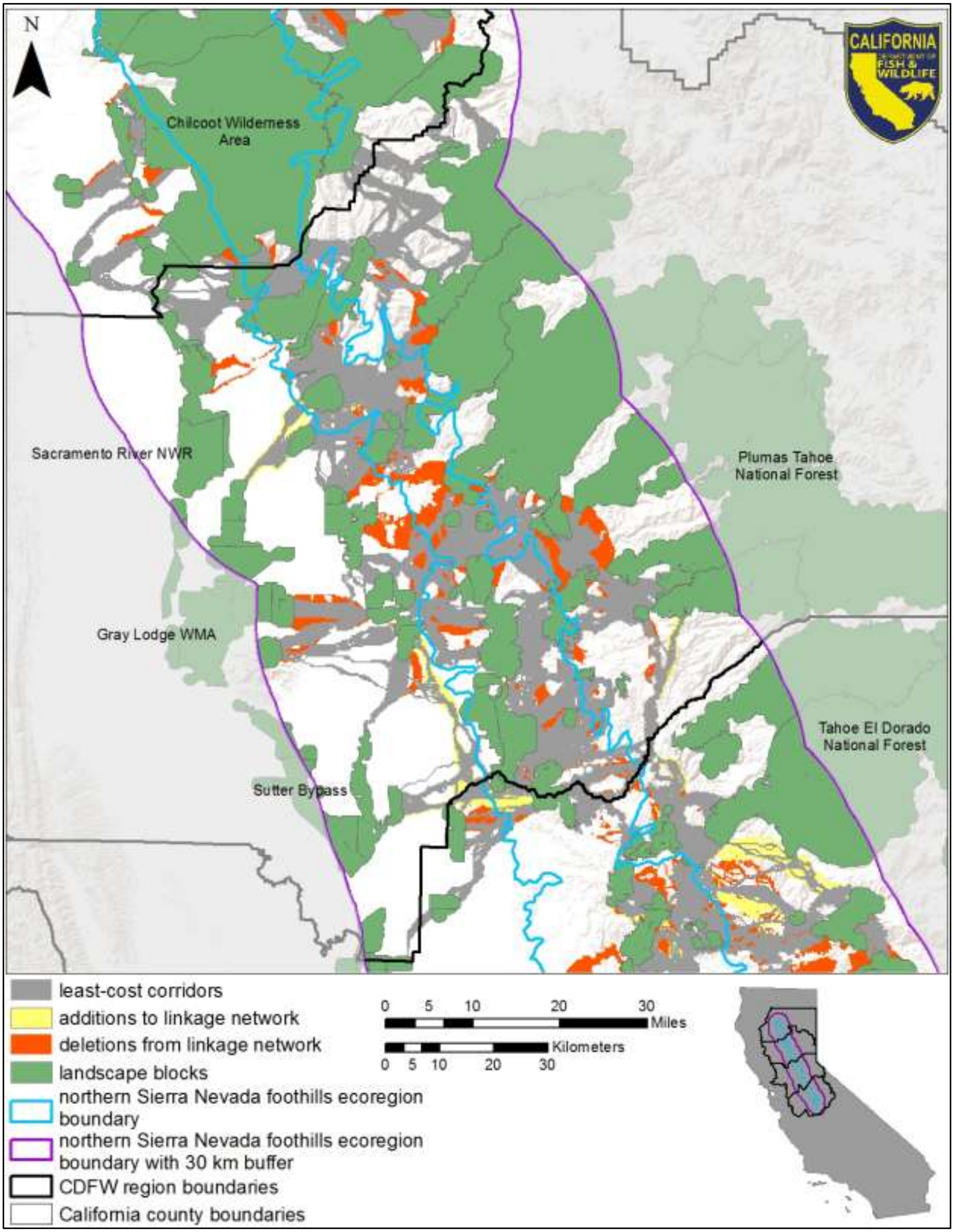


Figure 4. Final wildlife linkages showing additions and deletions. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 North subsection.

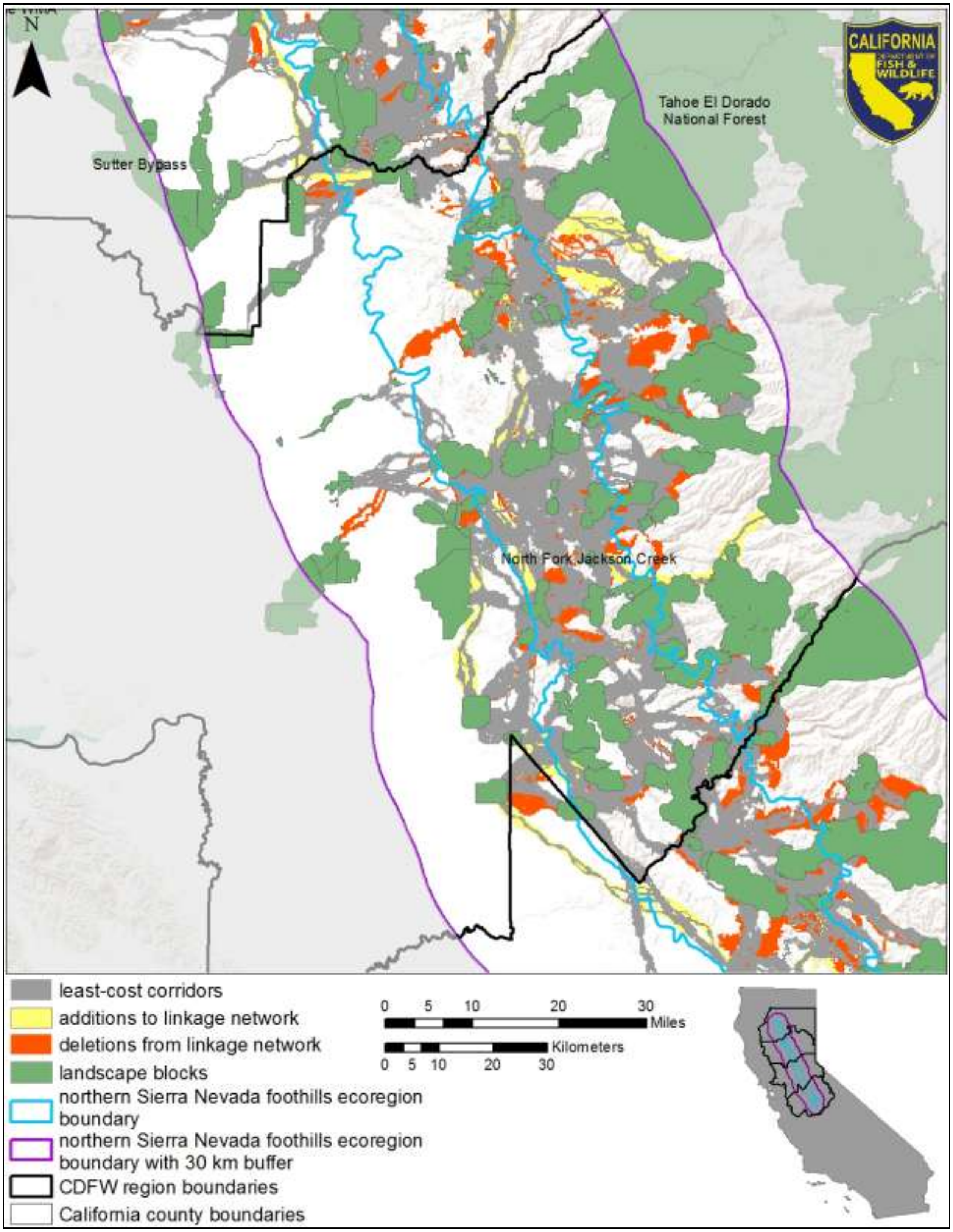


Figure 5. Final wildlife linkages showing additions and deletions. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 South subsection.

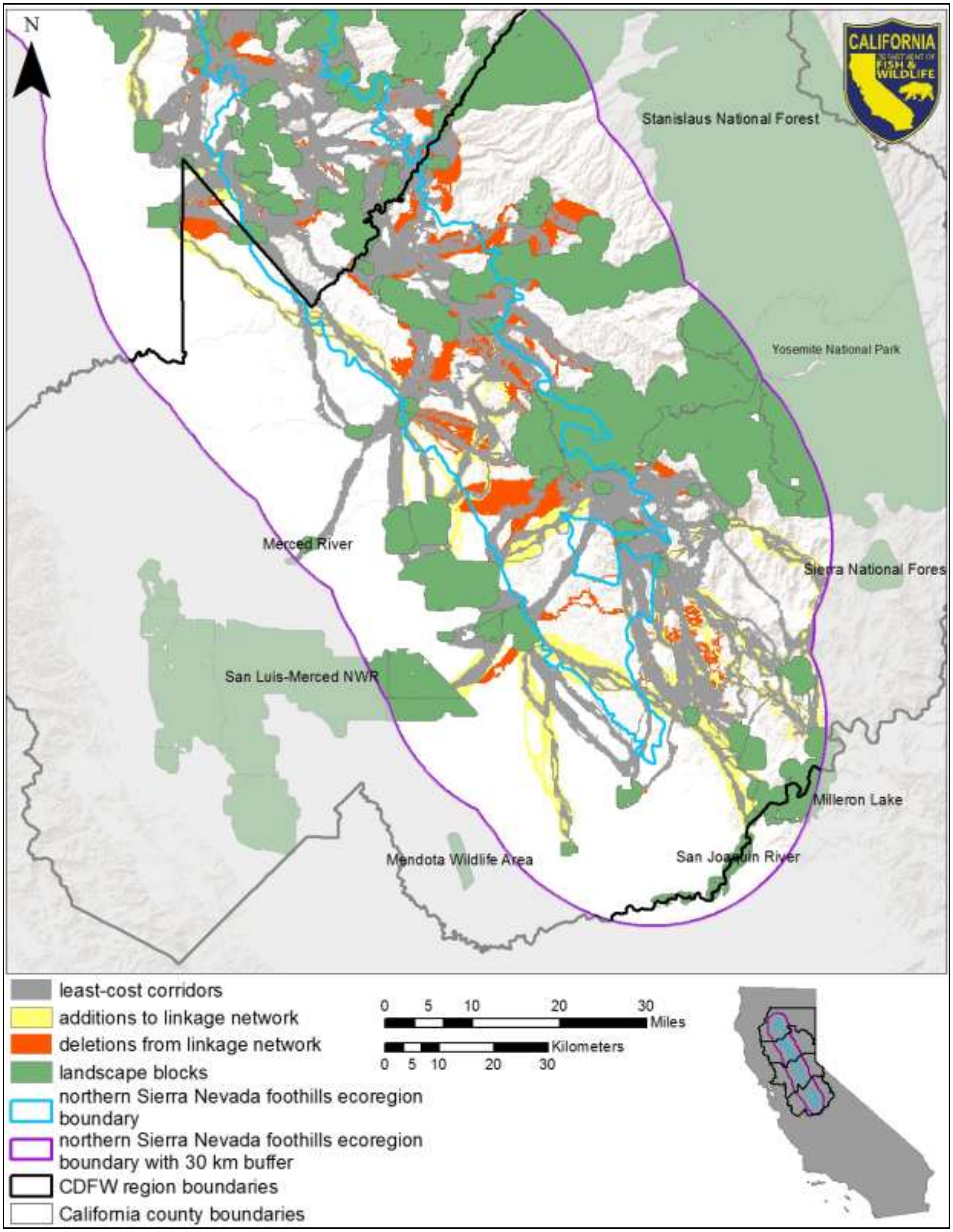


Figure 6. Final wildlife linkages showing additions and deletions. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 4 subsection.

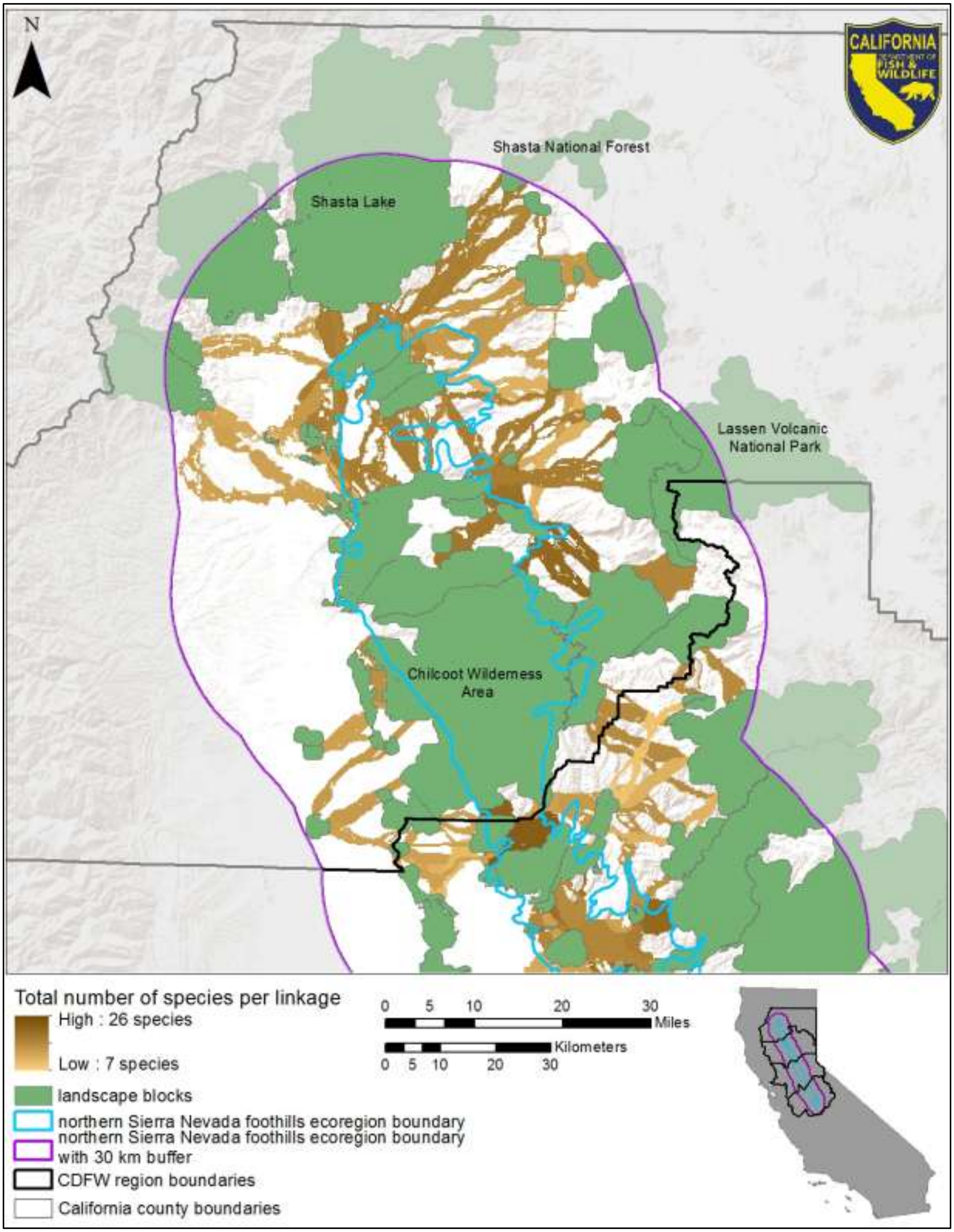


Figure 7. Final wildlife linkages showing number of focal species per linkage. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 1 subsection.

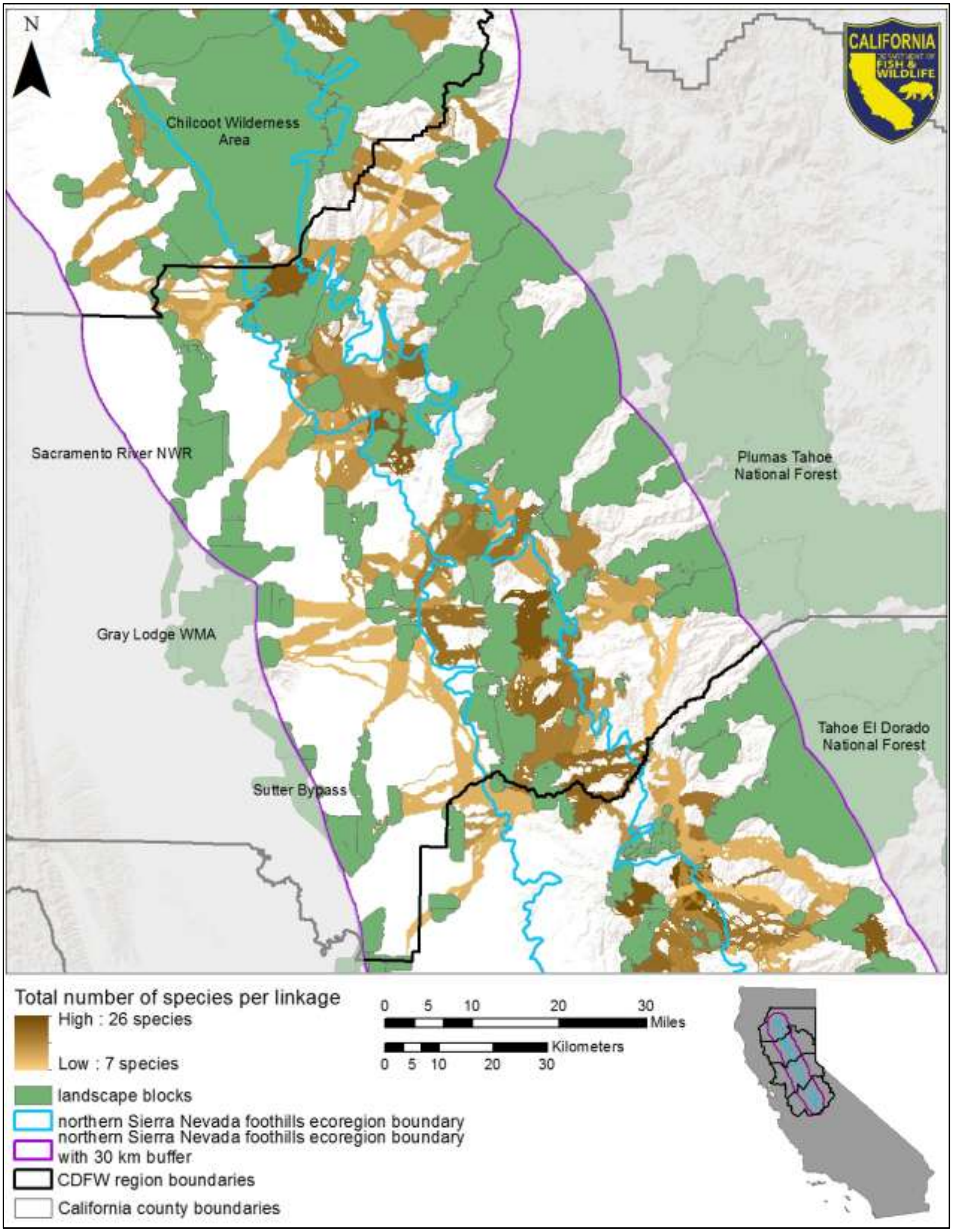


Figure 8. Final wildlife linkages showing number of focal species per linkage. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 North subsection.

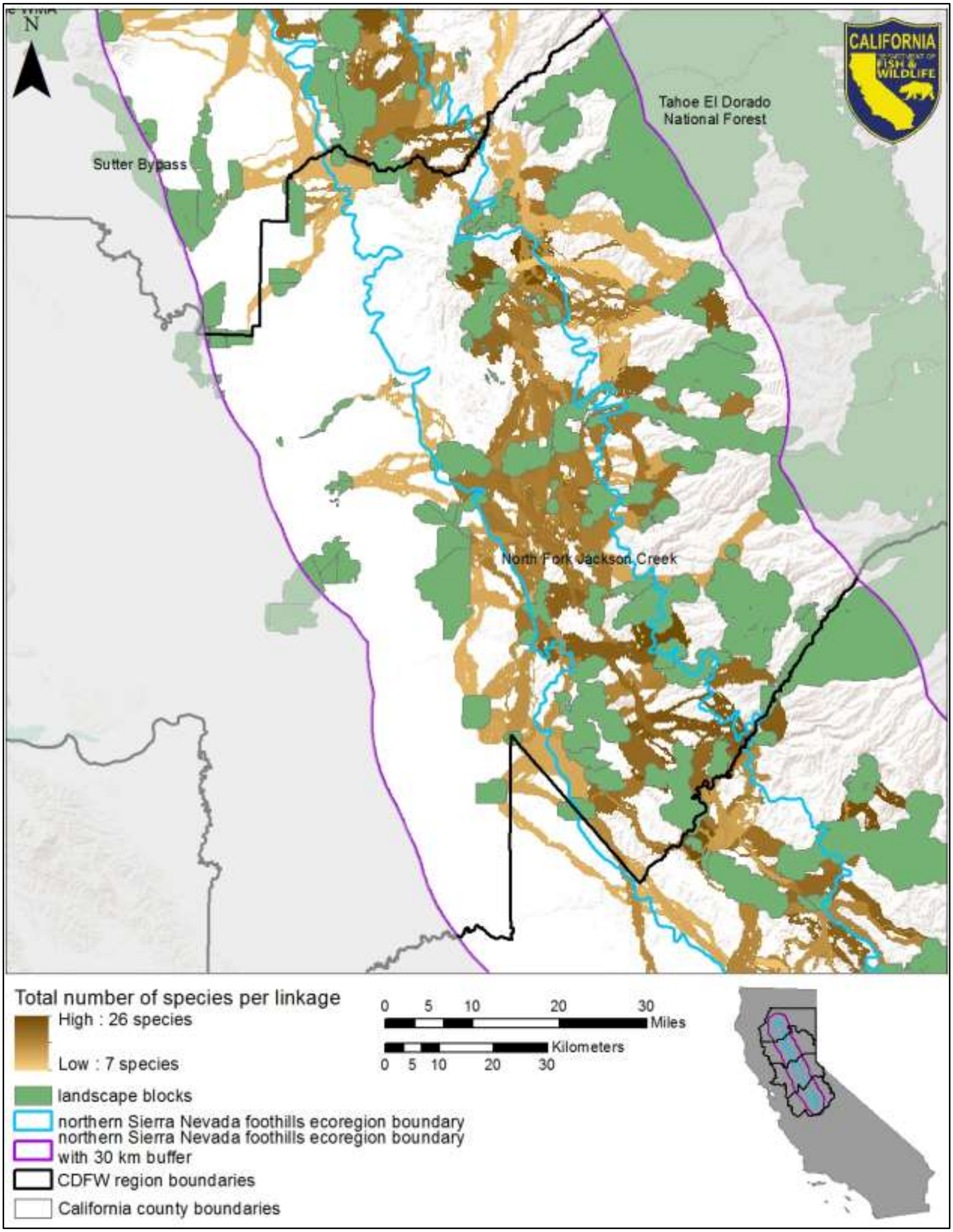


Figure 9. Final wildlife linkages showing number of focal species per linkage. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 South subsection.

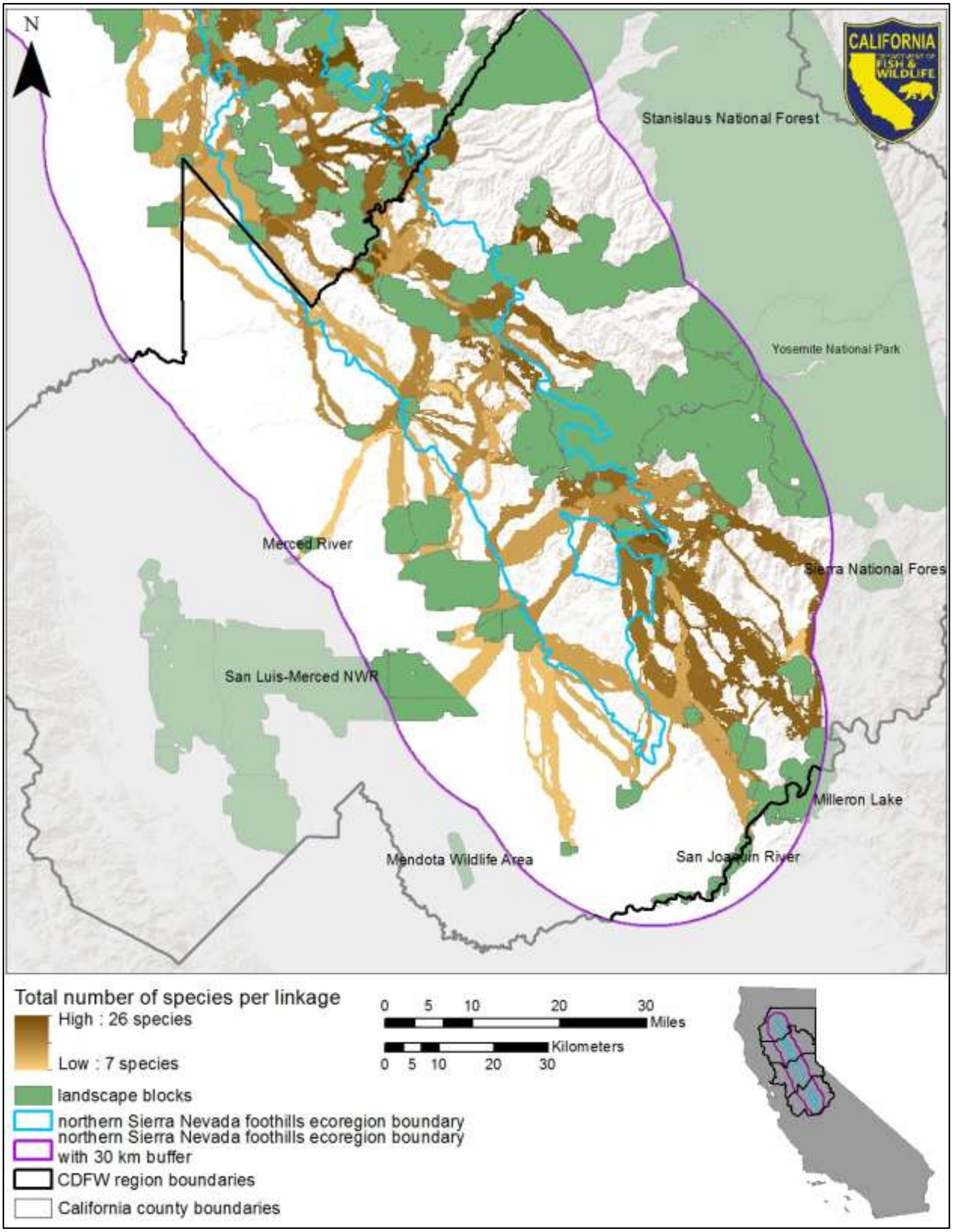


Figure 10. Final wildlife linkages showing number of focal species per linkage. Northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 South subsection.

4.6 Riparian Corridors

Riparian corridors are important areas that maintain connectivity throughout the state of California (Spencer et al. 2010) and are important areas for movement for many species including predators (Hilty and Merenlender 2004). The riparian corridors complement the linkages to further achieve connectivity in the study area. We identified 280 riparian corridors represented by 232 named creeks, 43 named rivers and 5 sloughs, forks or runs. The major corridors are the Sacramento, San Joaquin, Pit, Tuolumne, Merced, Feather and Stanislaus Rivers. The 280 riparian corridors connect 201 landscape blocks. The riparian corridors complement the focal species linkages by providing many east-west corridors while the majority of linkages have a north-south orientation. Also by following the entire passage of the riparian area, these corridors run through many of the landscape blocks across the study area helping to provide connectivity outside of habitat patch areas.

The riparian corridors covered 733,607.5 ha of which 32.8% are in protected lands (GAP status 1, 2, or 3 or conservation easement). Many of the riparian corridors cross the landscape blocks and linkages, 39.8% of the riparian corridors occur within the landscape blocks, while 36% are within the linkages.

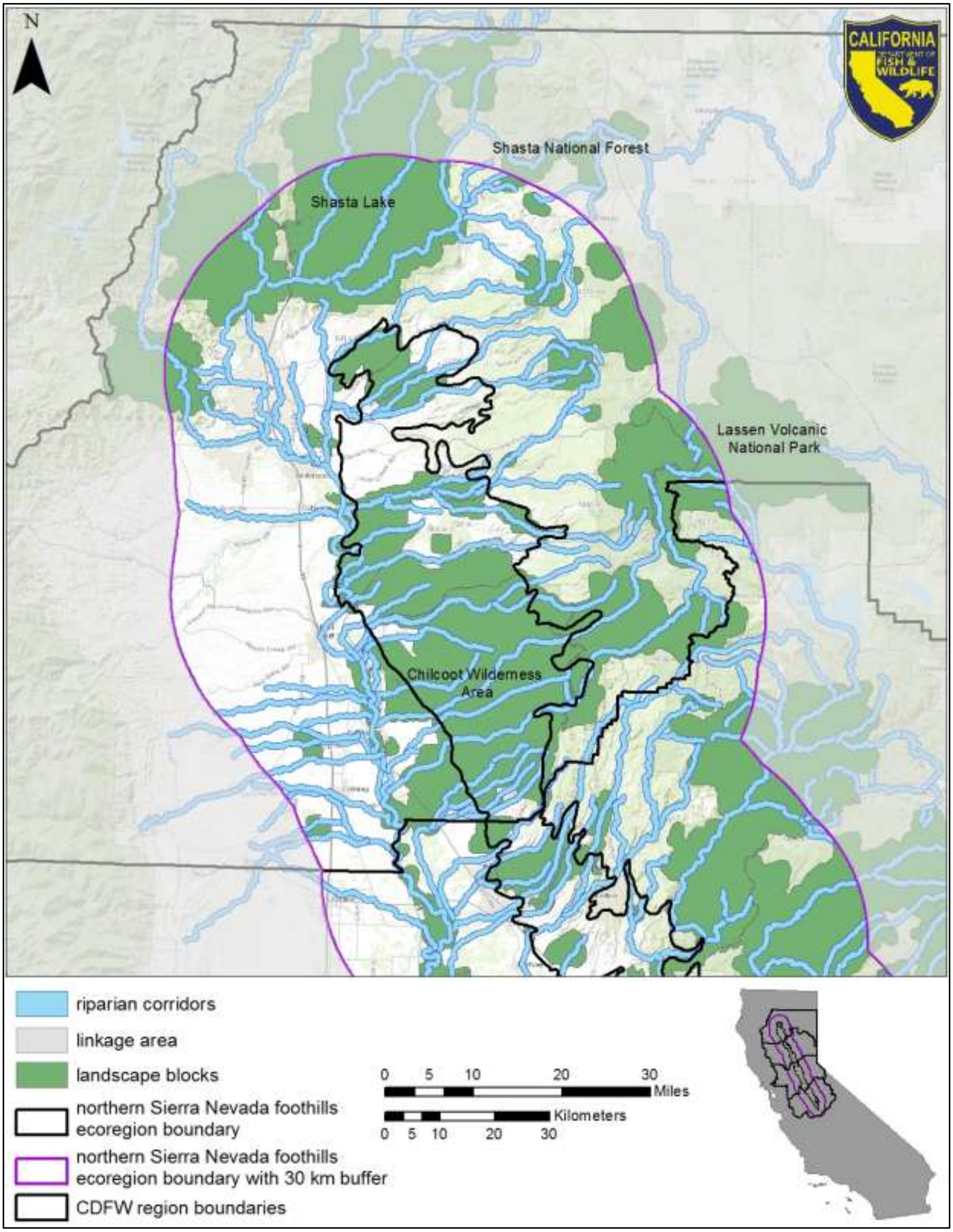


Figure 11. Riparian corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 1 subsection.

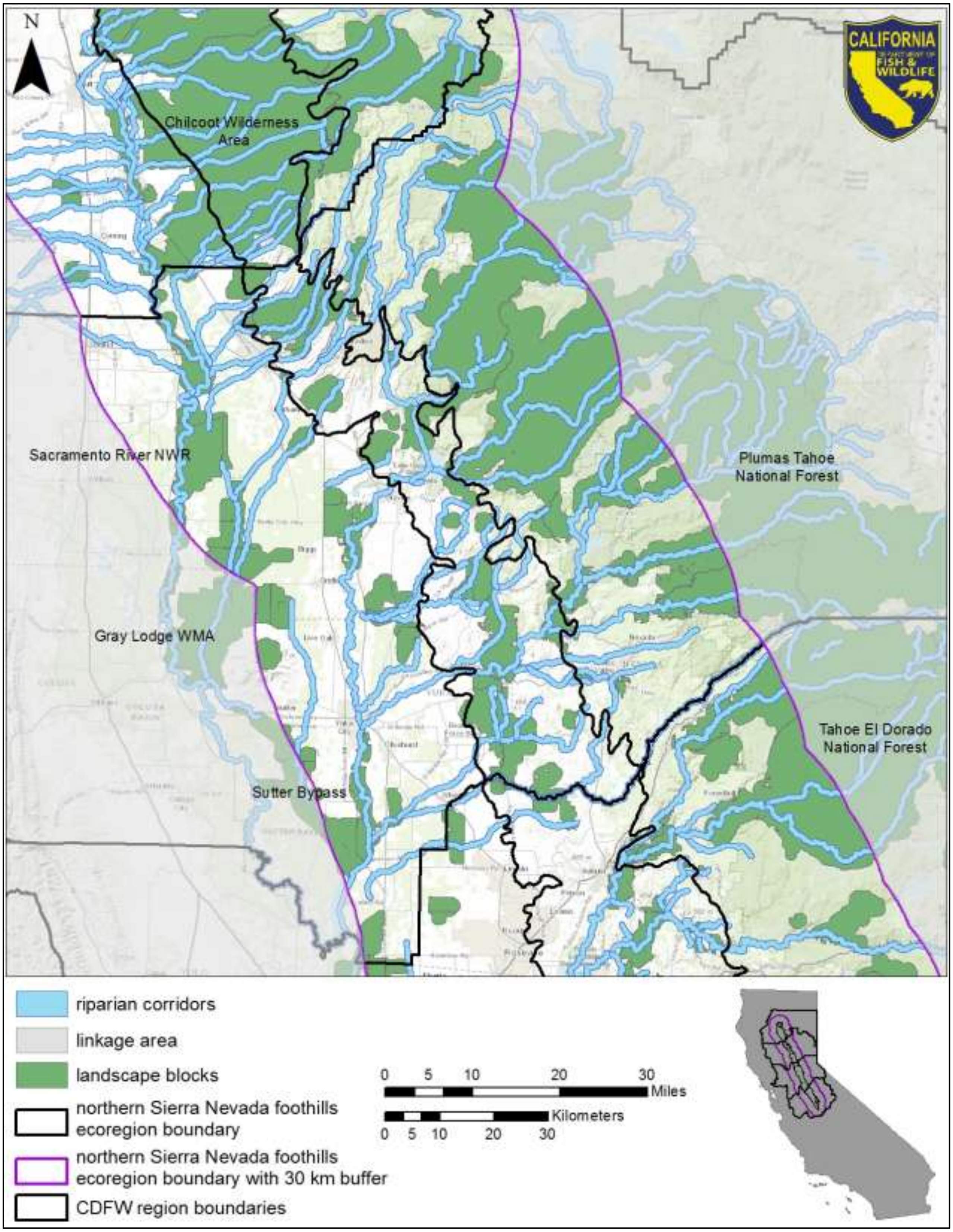


Figure 12. Riparian corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 North subsection.

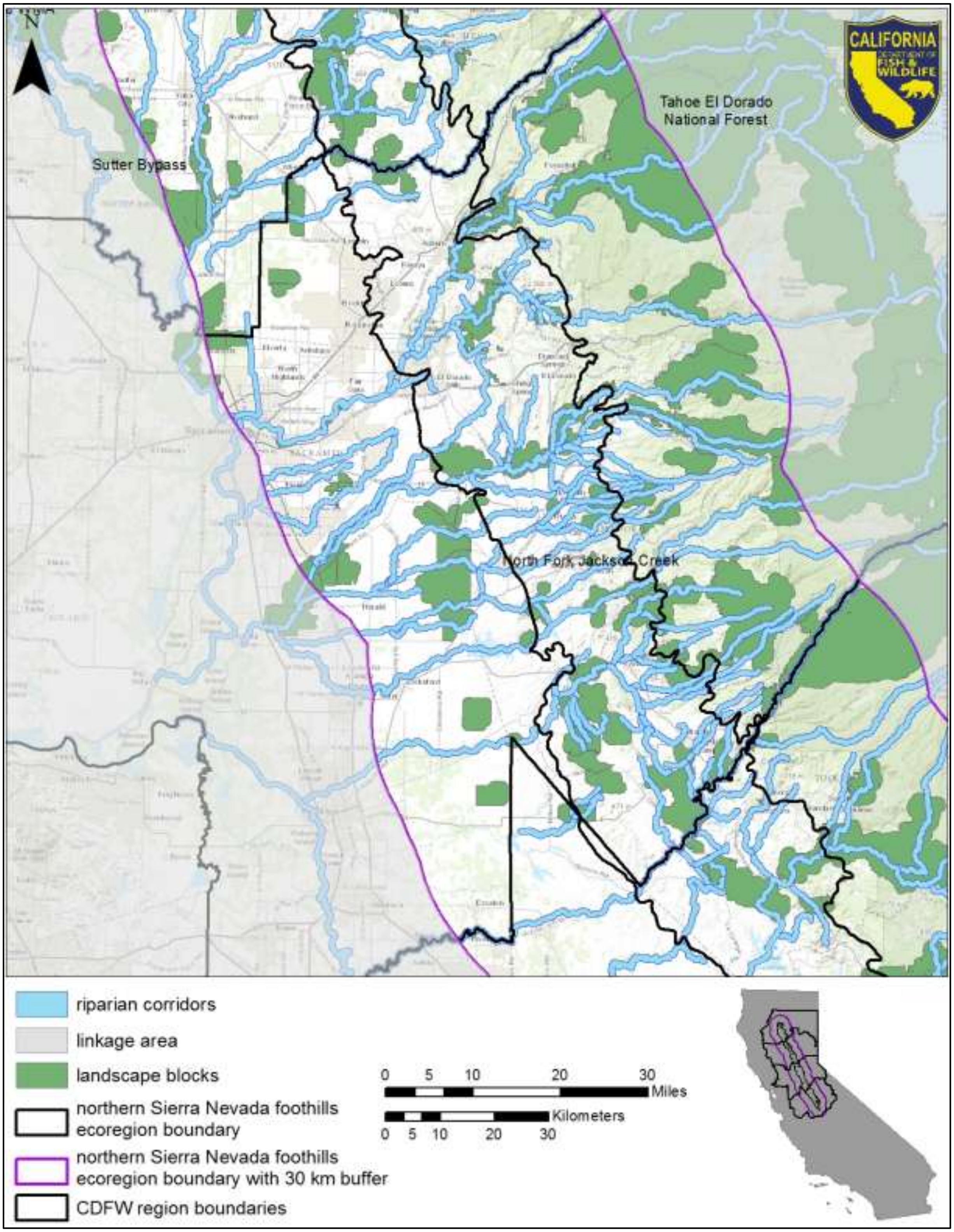


Figure 13. Riparian corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 South subsection.

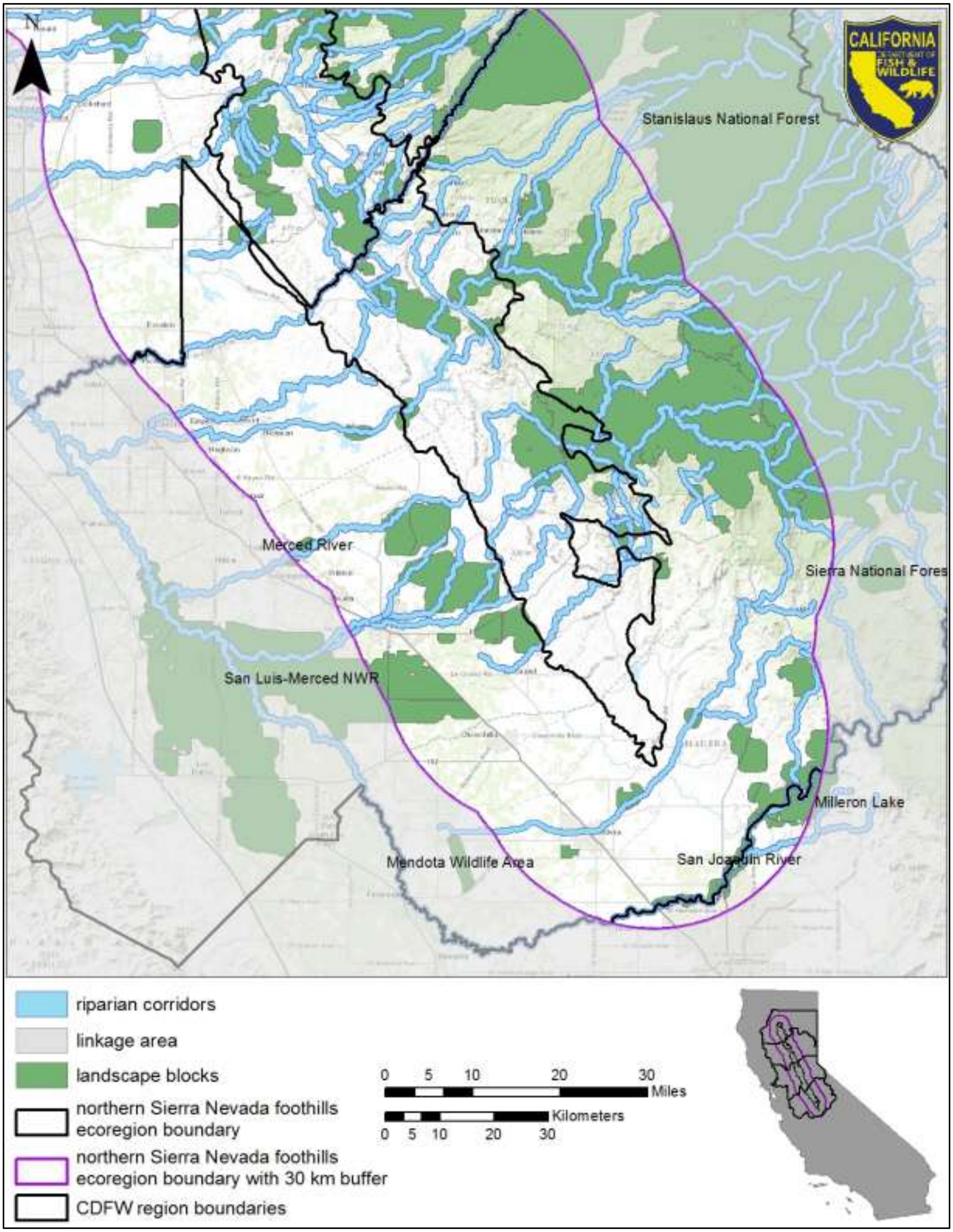


Figure 14. Riparian corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 4 subsection.

4.7 Land Facet Corridors

We identified 3 categories of land facets across the study area (canyons, slopes, and ridges) and 11 individual facets: low elevation gentle canyons; high elevation steep canyons; high elevation gentle canyons; low elevation, flat, warm slopes; mid-elevation gentle, warm slopes; steep, cool slopes; steep, hot slopes; high elevation gentle hot slopes; high elevation steep slopes; low elevation gentle ridges; high elevation steep ridges; and high elevation gentle ridges (Table 9). We identified 169 land facet corridors, connecting 94 landscape blocks. The land facet corridors complement the focal species linkages and riparian corridors by providing many connections between landscape blocks missed by the other corridors.

Table 9. Mean, minimum, and maximum values of topographic attributes for each land facet.

	Land Facets	Elevation			Slope			Insolation			Description
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Class 1 - Canyons	Land facet 1	479.41	16.00	977.00	10.73	0.00	23.71	–	–	–	Low elevation, gentle
	Land facet 2	748.80	69.00	1869.00	30.47	20.44	69.50	–	–	–	High elevation, steep
	Land facet 3	1425.19	979.00	3059.00	14.06	0.00	42.66	–	–	–	High elevation, gentle
Class 2 - Slopes	Land facet 1	117.10	0.00	693.00	1.78	0.00	13.38	1248.52	1083.69	1340.73	Low elevation, flat, warm
	Land facet 2	652.91	21.00	1568.00	10.66	0.00	24.54	1318.67	1106.17	1473.22	Mid elevation, gentle, warm
	Land facet 3	745.77	55.00	3022.00	26.72	14.26	71.12	1026.02	323.92	1221.02	All elevation, steep, cool
	Land facet 4	993.53	84.00	2585.00	24.76	15.13	58.30	1402.19	1189.94	1673.59	All elevation, steep, hot
	Land facet 5	1551.93	952.00	3137.00	8.92	0.00	33.97	1494.77	1284.50	1890.24	High elevation, gentle, hot
Class 3 - Ridges	Land facet 1	546.17	34.00	1037.00	11.07	0.00	23.43	–	–	–	Low elevation, gentle
	Land facet 2	833.98	72.00	2392.00	29.62	20.22	69.82	–	–	–	High elevation, steep
	Land facet 3	1500.66	1071.00	3171.00	13.34	0.00	39.79	–	–	–	High elevation, gentle

The land facet corridors covered 512,359.8 ha of which 19.5% are in protected lands (GAP status 1, 2, or 3 or conservation easement and 80.5% occurred on private land.

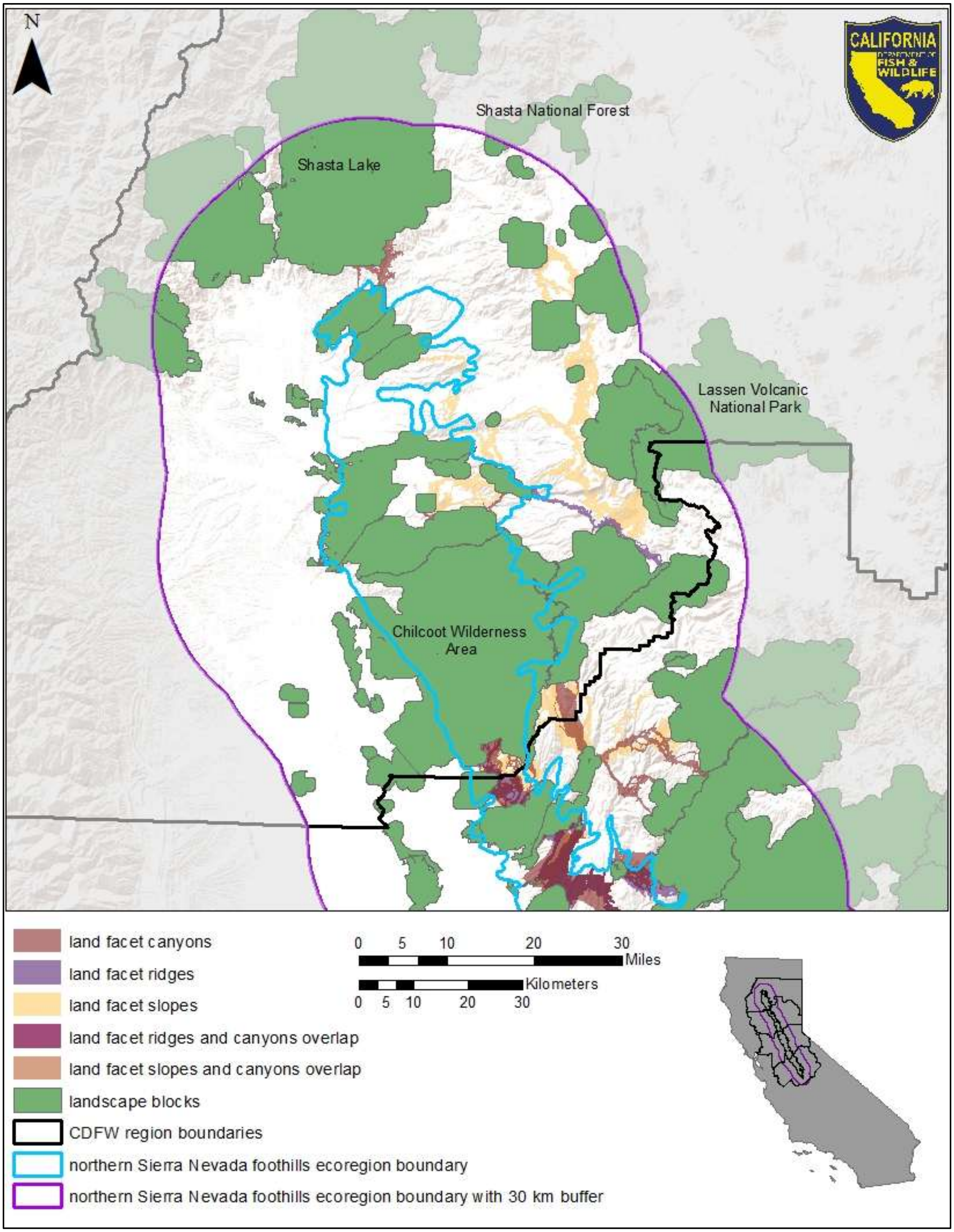


Figure 15. Land facet corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 1 subsection.

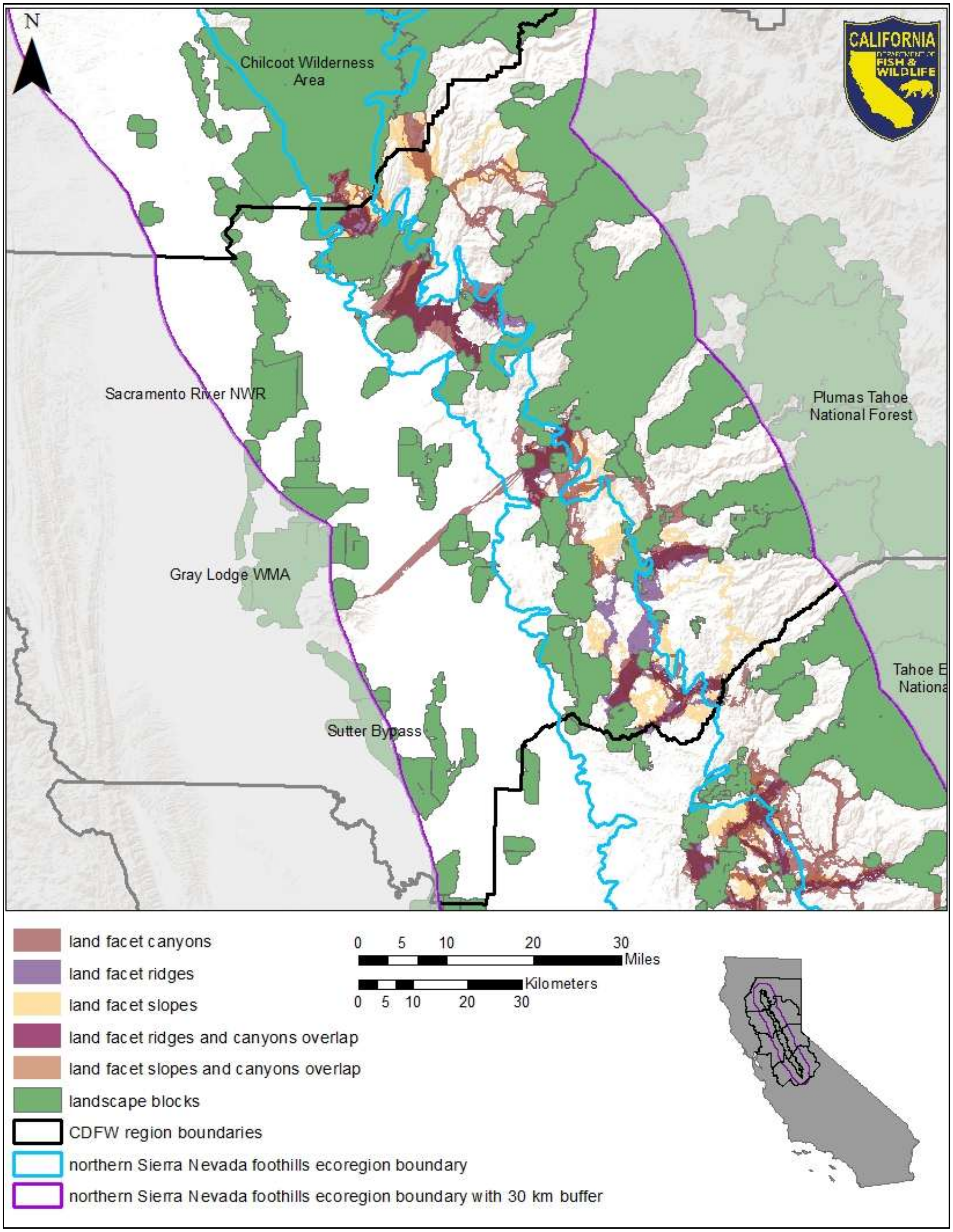


Figure 16. Land facet corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 North subsection.

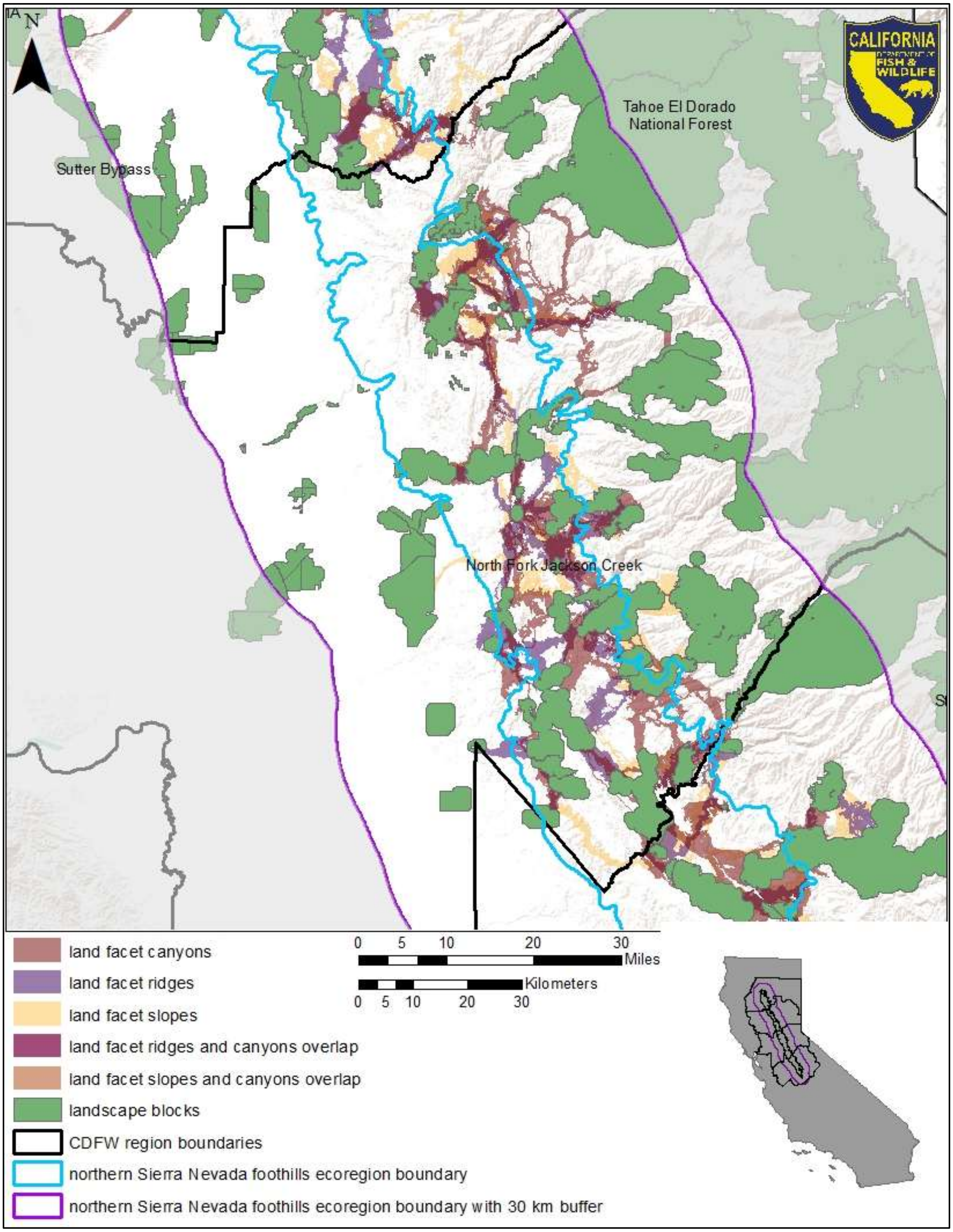


Figure 17. Land facet corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 2 South subsection

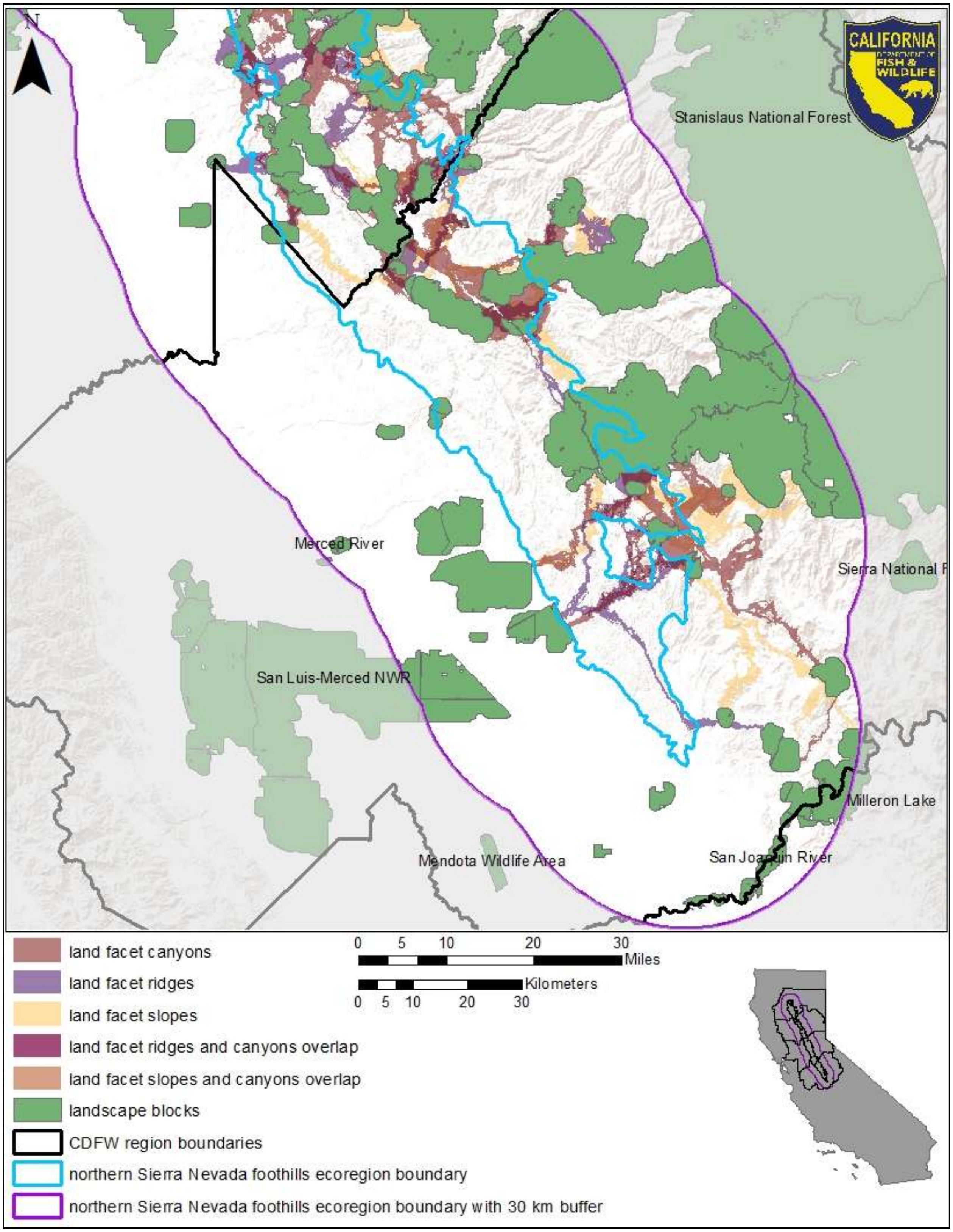


Figure 18. Land facet corridors, northern Sierra Nevada foothills fine-scale connectivity analysis, CDFW Region 4 subsection

4.8 Comparison of Linkages, Riparian Corridors and Land Facet Corridors

We compared how well the three corridors types captured the habitat of the nine passage species to better understand how the corridors captured wildlife habitat needs across the study area. The first calculation compared the total amount of habitat with total corridor area and found the wildlife linkages capture twice as much available habitat (50.7%) compared to the riparian corridors (20.4%) and land facet corridors (25.1%; Table 10). The second calculation compared the percentage of wildlife habitat within the corridors and found all three methods performed similarly (Table 10).

Table 10. Comparison of predicted suitable habitat and corridor area for 9 passage species.

Land Facet Corridors					
percentage of total predicted suitable habitat falling inside corridors					
	low	med	high	total	Percentage of corridor mapped as suitable habitat
BLBE	30.1%	26.5%	30.8%	28.6%	76.6%
BOBC	10.0%	31.2%	37.4%	19.6%	99.9%
BTJA	20.9%	31.4%	15.0%	23.2%	51.7%
DFWO	28.5%	32.9%	11.9%	29.0%	79.9%
GRFO	10.8%	36.1%	40.8%	19.1%	100.0%
MOLI	20.0%	32.1%	29.6%	27.6%	95.1%
MUDE	20.7%	21.5%	21.0%	21.3%	90.5%
WGSQ	33.3%	19.6%	9.2%	28.1%	87.5%
WPTU	31.7%	17.9%	32.5%	29.3%	87.2%
AVERAGE			**25.4%**	**25.1%**	**85.4%**
Riparian Corridors					
percentage of total predicted suitable habitat falling inside corridors					
	low	med	high	total	Percentage of corridor mapped as suitable habitat
BLBE	17.5%	21.3%	20.3%	19.3%	62.3%
BOBC	16.7%	19.2%	16.3%	17.3%	95.8%
BTJA	20.4%	29.5%	35.0%	22.5%	54.4%
DFWO	21.3%	30.1%	28.7%	22.3%	66.9%
GRFO	16.5%	19.9%	16.8%	17.1%	97.2%
MOLI	15.4%	19.4%	25.7%	20.4%	76.3%
MUDE	7.5%	18.7%	30.6%	20.0%	92.1%
WGSQ	22.2%	20.1%	14.4%	21.2%	72.5%
WPTU	15.9%	32.0%	47.6%	23.6%	76.6%
AVERAGE			**26.2%**	**20.4%**	**77.1%**

Wildlife Linkages					
percentage of total predicted suitable habitat falling inside linkages					
	low	med	high	total	Percentage of linkages mapped as suitable habitat
BLBE	47.0%	42.2%	53.6%	45.3%	62.2%
BOBC	29.6%	52.9%	79.8%	43.1%	99.5%
BTJA	50.1%	85.0%	23.3%	57.7%	58.2%
DFWO	54.3%	65.0%	35.9%	55.5%	69.3%
GRFO	30.5%	59.5%	80.7%	42.0%	99.6%
MOLI	45.9%	56.8%	52.3%	51.9%	81.1%
MUDE	32.7%	49.3%	52.4%	48.4%	93.1%
WGSQ	60.8%	35.5%	39.6%	52.3%	75.4%
WPTU	56.2%	53.4%	82.5%	59.7%	80.4%
AVERAGE			**55.6%**	**50.7%**	**79.9%**

4.9 Comparison of the NSNF Wildlife Connectivity to other Conservation Strategies

Although no other wildlife connectivity analysis has been completed for the foothills we compared the landscape blocks and linkages to other conservation strategies for the study area. This comparison is not exhaustive, but illustrates conservation efforts across the foothills ecoregion.

4.9.1 California Essential Habitat Connectivity Project

The California Department of Transportation and California Department of Fish and Wildlife commissioned the California Essential Habitat Connectivity Project (CEHC). The CEHC developed a statewide essential habitat connectivity map that depicts large relatively natural habitat blocks of land that support native biodiversity and areas essential for ecological connectivity between them (Spencer et al. 2010). Developed for the entire state of California, the project is at a coarse scale and based primarily on the concept of ecological integrity (Davis et al. 2003, Davis et al. 2006), rather than the needs of particular species (Spencer et al. 2010). The CEHC connectivity map depicts 850 large natural habitat blocks (Natural Landscape Blocks) and 192 areas essential for ecological connectivity (Essential Connectivity Areas; ECA). Thirty-six ECAs overlap with the study area with 3,731,374.7 acres. Thirty-three ECAs overlap the landscape blocks, 27 overlap the linkages, 33 overlap the riparian corridors and 21 overlap the land facet corridors (Table 7).

Table 11. Overlap between landscape blocks and linkages with the California Essential Habitat Connectivity Areas.

Name	ECA Area (ac)	Acres of ECA in landscape blocks	Acres of ECA in linkages	Percent of ECA in LB and linkages	Acres of ECA in riparian corridors	Acres of ECA in land facet corridors
Bald Hills - Castle Crags	156,879.70	116,823.87	9,407.05	80.5	18,951.62	-
Bear Mountains - Duck Creek	80,841.86	28,465.01	35,110.76	78.6	14,220.68	12,514.64
Bear Mountains - Middle Fork Cosumnes River	131,919.96	35,800.24	70,466.95	80.6	41,005.17	84,284.51
Bear River - Chaparral Hill/ Yuba River	61,415.67	39,019.20	19,846.99	95.8	15,620.63	22,889.75
Bear Slough - Browns Creek	33,798.65	9,435.20	21.65	28.0	3,979.96	-
Big Bar Mountain/ Stevens Ridge - Ishi Wilderness	662,497.57	435,422.98	87,590.08	78.9	137,804.23	67,126.75
Calaveras Big Trees - Pine Ridge	35,541.59	26,657.91	-	75.0	10,080.57	-
Chaparral Hill/ Yuba River - Bald Mountain Range	71,902.08	43,197.71	23,230.45	92.4	15,085.49	19,196.19
Cherokee Creek - Pine Ridge	53,159.93	20,458.58	15,450.22	67.5	17,629.48	19,245.44
Coon Creek - Bear River	47,334.74	10,295.24	24,817.87	74.2	8,440.00	199.24
Coyote Ridge - Owens Mountain	810.93	-	-	-	59.86	-
Curry Creek - Coon Creek	19,466.89	4,086.95	2,185.90	32.2	476.32	-
Duck Creek North Fork - Coyote Creek	126,166.35	50,379.72	26,863.63	61.2	19,020.75	640.81
Eastman Lake NRA - Bear Creek	76,181.63	16,505.37	23,946.55	53.1	744.34	-
Flat Top Mountain - Hunter Valley Mountain	65,258.65	10,337.00	24,152.33	52.9	10,312.67	19,778.54
Gravelly Ford Canal - Fresno River	786.68	-	-	-	-	-
Gravelly Ford Canal - Lone Willow	1,226.96	-	-	-	-	-
Hunter Valley Mountain - Cardoza Ridge	38,253.03	6,358.98	13,843.56	52.8	2,531.29	-
Lassen Volcanic Wilderness - Beaver Creek Rim/ Indian Mountain	12,297.31	12,234.44	-	99.5	4,522.20	-
Lassen Volcanic Wilderness - Thousand Lakes	71,904.27	61,816.37	-	86.0	7,108.90	1,354.67

Name	ECA Area (ac)	Acres of ECA in landscape blocks	Acres of ECA in linkages	Percent of ECA in LB and linkages	Acres of ECA in riparian corridors	Acres of ECA in land facet corridors
Marble Valley - Sawtooth Ridge	205,614.66	102,888.99	26,190.50	62.8	42,157.03	23,630.71
McCloud River/ Curl Ridge - McConaughy Gulch	11,393.88	11,393.88	-	100	1,840.60	-
McClure Creek - Table Mountain	101,018.63	29,202.22	70.40	29.0	25,219.04	-
Middle Fork Cosumnes River - Big Mountain Ridge	35,810.91	10,978.11	14,887.58	72.2	11,736.25	1,299.05
Mill Creek Rim - Lassen Volcanic Wilderness	136,501.11	103,809.18	12,445.89	85.2	28,490.74	21,767.27
Mooney Island - Ishi Wilderness	77,827.08	71,129.29	4,409.92	97.1	22,819.65	-
North Table Mountain - Ishi Wilderness	387,935.35	198,402.77	110,345.78	79.6	93,090.88	110,650.03
Orland Buttes/ Stone Valley/ Julian Rocks - Ishi Wilderness	243,293.25	180,183.48	21,697.28	83.0	72,541.77	12,951.60
Pine Ridge - Irish Hill	156,322.23	42,787.29	73,868.17	74.6	39,009.93	77,832.92
Pine Ridge - Lightning Mountain	59,719.85	33,670.13	-	56.4	12,118.79	-
Popcorn Cave - Curl Ridge	16,891.10	10,364.20	160.48	62.3	3,702.05	-
Quartz Mountain - Logtown Ridge	23,812.93	7,601.92	15,165.93	95.6	10,172.16	16,773.79
Sturdevant Ridge - Mosquito Ridge/ Crystal Ridge	68,587.48	32,929.82	9,697.23	62.1	7,700.85	2,257.46
Table Mountain - Lassen Volcanic Wilderness	183,488.81	127,188.02	36,254.54	89.1	37,448.90	15,428.66
Table Top Mountain - Gopher Ridge	256,555.13	27,615.64	66,567.25	36.7	27,787.70	3,832.92
Thousand Lakes - Cinder Butte	18,957.85	18,957.85	-	100	-	560.85

4.9.2 Missing Linkages

The Missing Linkages: Restoring Connectivity to the California Landscape was developed by a group of land managers, planners, scientist and conservationist from across the state that met to identify the location of and threats to wildlife movement corridors in California at a conference in 2000 (Penrod et al. 2001). This project identified 232 landscape linkages, each represented by a placeholder arrow.

Twenty-seven of the statewide Missing Linkages arrows were within the study area (Figure 19). The landscape blocks intersect 27 of the linkage arrows. The wildlife linkages intersect with 22 of the linkage arrows. A combination of landscape blocks and linkages captures the Sacramento Valley Grassland, Upper Cosumnes River, N-S Oak woodland in El Dorado landscape linkage arrows completely. The riparian corridors intersect with 16 of the linkage arrows, while the land facet corridors intersect with 10 of the linkage arrows.

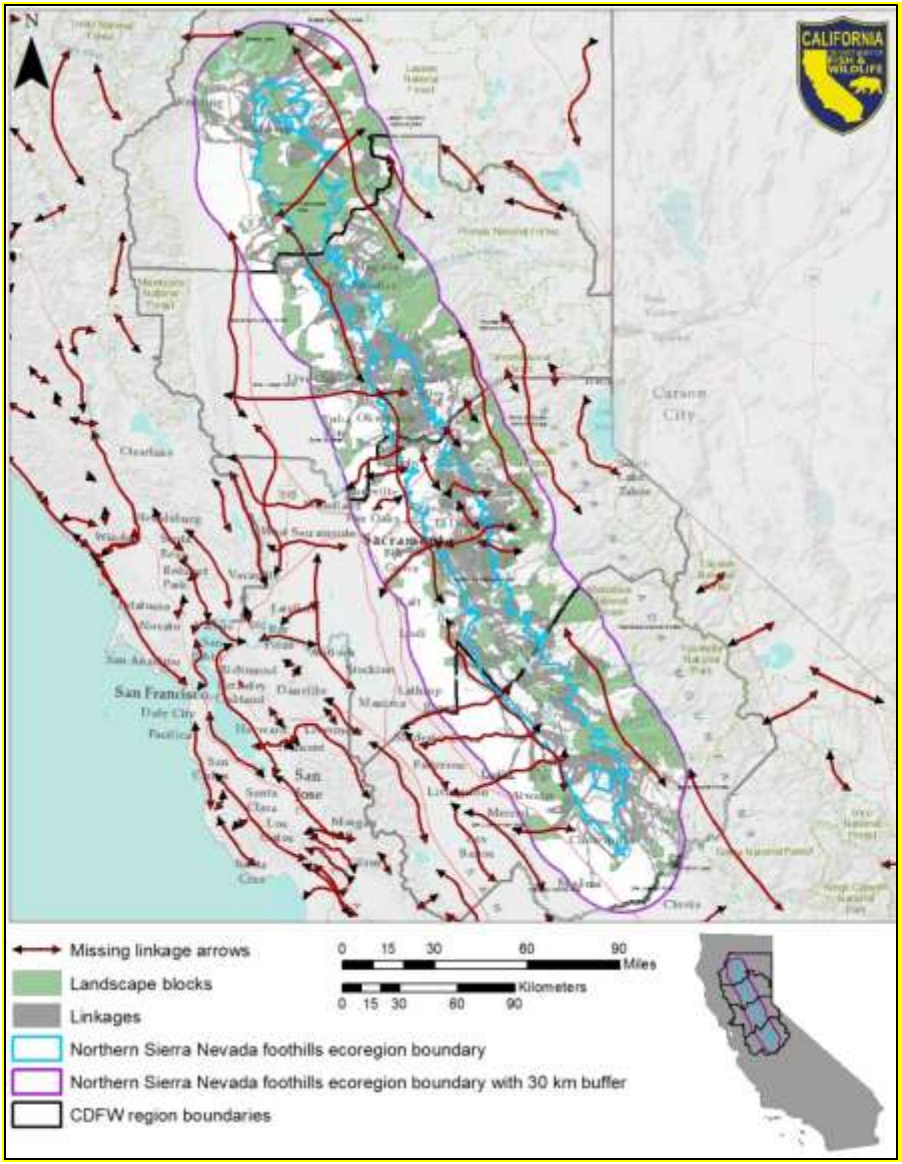


Figure 19. Northern Sierra Nevada foothills fine-scale connectivity analysis comparison with 2001 California Missing Linkages Project.

4.9.3 Habitat Conservation Plans/ Natural Community Conservation Plans

Habitat conservation plans (HCP) are long term agreements between an applicant, in many cases county government, and the US Fish and Wildlife Service. An HCP is designed to offset any harmful effects that a proposed activity might have on federally-listed threatened or endangered species. The HCP process allows development to proceed while providing a conservation basis to conserve the species and provide for incidental take. Natural Community Conservation Plans (NCCP) program is an effort between the State of California and numerous private and public partners, to develop a broad based ecosystem approach to planning for the protection of biological diversity. An NCCP identifies and provides for the regional or area wide protection of plants, animals and their habitats, while allowing compatible and appropriate economic activity. There are 12 HCP/NCCPs across the study area, covering 3,251,415.7 ha of land. The landscape blocks include 25.6% of HCP/NCCPs, 46.3% of the HCP/NCCPs are included within the linkages, 16.7% of the HCP/NCCPs are included within the riparian corridors, and 11.7% of the HCP/NCCPs are included within the land facet corridors (Table 8).

Table 12. Overlap between the landscape blocks and linkages with Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP).

NAME	HCP/NCCP Area (ac)	Acres of HCP/NCCP in landscape blocks	Acres of HCP/NCCP in linkages	Percent of HCP/NCCP in LB and linkages	Acres of HCP/NCCP in riparian corridors	Acres of HCP/NCCP in land facet corridors
Bay/Delta Conservation Plan	93.65	-	-	-	84.84	-
Butte Regional Conservation Plan	553,637.13	154,877.37	348,154.31	90.9	98,201.00	42,594.93
Calaveras County	603,425.49	189,060.50	384,046.47	95.0	137,438.76	177,569.88
East Fresno	30,908.49	11,040.32	1,131.06	39.4	5,462.25	-
El Dorado County	692,890.03	186,683.26	448,734.14	91.7	115,522.66	149,028.94
Natomas Basin	41,956.50	12,494.99	129.64	30.1	2,971.66	-
Placer County Conservation Plan Phase I	212,764.68	22,461.91	79,544.88	47.9	16,484.68	1,048.61
Placer County Conservation Plan Phase II And III	243,558.78	128,378.09	60,391.05	77.5	40,738.44	10,738.42
San Joaquin County	290,675.98	20,206.03	34,542.68	18.8	23,706.62	-
South Sacramento	282,076.78	57,291.29	51,068.95	38.4	58,160.94	2.55
Yolo Natural Heritage Program	557.32	-	-	-	391.94	-
Yuba-Sutter	298,870.92	51,316.45	99,237.66	50.4	45,389.50	1,298.59

4.9.4 USFWS Critical Habitat

California is home to over 300 threatened and endangered species (http://ecos.fws.gov) and has designated over 15,976,045.1 acres as critical habitat. The foothills are home to many threatened and endangered species, 17 of those species have 1,512,026.9 acres designated as critical habitat within the study area. Over 60% of the critical habitat in the study area was captured within the landscape blocks (30%; 456,673 ac) and linkages (31%; 469,556 ac). The landscape blocks and linkages captured 50% or more of the critical habitat for 10 of the 17 species, while only one species was not captured by the landscape blocks or linkages (Table 9). The riparian corridors captured 50% or more of the critical habitat for only 1 species the Valley Elderberry Longhorn Beetle. Land facet corridors captured 50% or more critical habitat for none of the species.

Table 13. Overlap between the landscape blocks and linkages and the USFWS critical habitat by species.

Common Name (Latin Name)	Total Critical Habitat (ac)	Acres Critical habitat in landscape blocks	Acres Critical habitat in linkages	Percent Critical or essential habitat covered by LB or linkage	Acres Critical habitat in riparian corridors	Acres Critical habitat in land facet corridors
Butte County Meadowfoam (*Limnanthes floccosa* ssp. *californica*)	16,644.20	6,703.35	8,046.63	88.6	3,299.14	-
California Red-legged Frog (*Rana draytonii*)	29,380.89	11,162.03	7,423.08	63.3	2,928.77	6,124.89
California Tiger Salamander (*Ambystoma californiense*)	99,393.70	42,995.63	31,361.18	74.8	10,260.04	1,135.55
Colusa Grass (*Neostapfia colusana*)	141,441.98	25,894.79	30,641.46	40.0	13,860.95	595.54
Conservancy Fairy Shrimp (*Branchinecta conservatio*)	90,377.72	36,466.92	25,870.31	69.0	9,528.96	945.52
Delta Smelt (*Hypomesus transpacificus*)	5,094.95	-	-	-	85.23	-
Fleshy Owl's-clover (*Castilleja campestris ssp. succulenta*)	160,943.99	38,340.33	30,579.83	42.8	15,364.43	945.52
Greene's Tuctoria (*Tuctoria greenei*)	143,349.11	35,211.19	37,326.52	50.6	17,997.83	945.52
Hairy Orcutt Grass (*Orcuttia pilosa*)	79,556.88	3,722.69	18,964.43	28.5	1,741.75	-

Common Name (Latin Name)	**Total Critical Habitat (ac)**	**Acres Critical habitat in landscape blocks**	**Acres Critical habitat in linkages**	**Percent Critical or essential habitat covered by LB or linkage**	**Acres Critical habitat in riparian corridors**	**Acres Critical habitat in land facet corridors**
Hoover's Spurge (*Chamaesyce hooveri*)	75,549.27	3,423.56	19,539.61	30.4	6,554.45	-
Northern Spotted Owl (*Strix occidentalis caurina*)	1,496.50	1,471.86	24.68	100.0	308.10	-
Sacramento Orcutt Grass (*Orcuttia viscida*)	33,277.12	15,444.45	1,237.78	50.1	5,878.65	-
San Joaquin Orcutt Grass (*Orcuttia inaequalis*)	120,143.74	24,947.36	32,215.09	47.6	8,377.65	595.54
Slender Orcutt Grass (*Orcuttia tenuis*)	63,310.69	46,946.09	5,523.88	82.9	18,868.33	-
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	514.75	480.13	-	93.3	434.25	-
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	271,611.16	78,438.14	35,739.37	42.0	29,183.19	595.88
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	184,941.61	86,494.17	45,503.47	71.4	31,472.49	349.97

4.9.5 The Nature Conservancy Priority Conservation Areas

The primary planning tool used by the Nature Conservancy for landscape-scale conservation planning over the past decade has been ecoregional assessments. The ecoregional planning is based on the design of a portfolio of priority conservation areas specific to each ecoregion. Each portfolio is a systematically defined collection of sites that vary enough to represent the natural communities and species of an ecoregion but in combinations that maximize efficiency. Connectivity is not explicitly accounted for within the portfolio, the conservation areas may be large enough to provide for movement. Over 2 million acres of land are delineated throughout the study area as conservation priorities or portfolio sites. A total of 66% of the conservation areas were captured by the landscape blocks and linkages, 27% by the riparian corridors and 10.5% by the land facet corridors (Table 10).

Table 14. Overlap between the landscape blocks and linkages with The Nature Conservancy Portfolio Sites in the study area.

Description of Comparison	Acres	Percent
TNC Priority Conservation Area Overlap with Study Area	2,666,505.17	24.6
TNC Priority Conservation Area Overlap with landscape blocks	1,286,008.45	48.2
TNC Priority Conservation Area Overlap with linkages	488,990.23	18.3
TNC Priority Conservation Area Overlap with riparian corridors	721,879.81	27.1
TNC Priority Conservation Area Overlap with land facet corridors	280,008.46	10.5

5 Discussion, conclusion and next steps

A connected landscape is crucial for maintaining ecological processes and healthy wildlife populations over time. There are many factors that influence wildlife movement including ecological attributes of the landscape, physical attributes of the landscape, and species behavior (Van Vuren 1998). A natural landscape without man-made barriers provides the greatest freedom for species to maintain natural movement patterns and for ecological processes to continue unhindered, although physical barriers to movement also exist in natural landscapes. A connectivity analysis can help us to better understand what barriers are present in the landscape, where they are located, how they may affect species movement, and can help us devise a strategy to maximize landscape connectivity in the future. The habitat patch analysis provides a way to see where the important core habitat areas for each species are located in the landscape and how they are juxtaposed with conservation lands, as well as to identify isolated habitat patches or habitat patches likely to become isolated in the future. The least-cost path analysis provides a robust methodology for identifying how the core habitat areas within conservation lands can best be linked together to support wildlife populations and wildlife movement over time. The maps of core habitat patches and wildlife linkages can be used to address species-specific conservation needs as well as overall habitat connectivity in conservation planning.

In some parts of the foothills, there were many corridors identified. This indicates that natural habitat in these areas is still relatively continuous and species have many options when moving across the landscape. For conservation, this means that there are likely a variety of opportunities to maintain connectivity for wildlife. Report Section 5.4, Prioritizing Linkages for Conservation, offers some suggestions for selecting linkages for conservation when multiple linkages have been identified in an area.

In some areas there was only a single corridor or no corridor identified between two neighboring blocks. This indicates that natural habitat is likely not continuous and wildlife movement between the blocks may be impeded by barriers. Restoration or other mitigation efforts may be required to achieve adequate connectivity between habitat patches when little natural connectivity is remaining. It is important to note that some linkages do cross highways and major roads, and a count of the number of major road crossings is available for each linkage. Linkages with many major road crossings may require special attention to ensure that the linkage adequately functions to provide wildlife connectivity. The linkages provide a hypothesis for potentially important road crossing locations, which could be field-tested with camera traps.

5.1 Wildlife connectivity and barriers in the foothills

For the purposes of analysis, discussion, and representation on maps, we split the study area into four subsections from north to south based on California Department Fish and Wildlife region boundaries (Regions 1, 2 and 4). Region 2 was further split into a northern and southern subsection by county boundaries.

The **NSNF Region 1 subsection** is the northernmost subsection of the study area and includes parts of Shasta, Tehama, and Plumas counties. The southwestern side of this study subsection has some agricultural and urban development from Corning to Red Bluff, in some places extending to the boundary of the foothills ecoregion. The northwestern side of this subsection includes the City of Redding and Shasta Lake and its tributaries, which pose barriers to movement to the north and west. Within the foothills and on the eastern side of the study area, natural habitat is fairly continuous and generally well-connected. Much of the foothills area in Tehama County is covered by a single landscape block (Chilcoot Wilderness Area Block) which includes various conservation lands including the Tehama Wildlife Area, the Nature Conservancy's Dye Creek Preserve and Vina Plains Preserve, and parts of the Lassen National Forest. Several large landscape blocks are found on the east side of the study area including Lassen National Forest and Lassen National Park. Linkages providing habitat for the largest number of focal species are located on the eastern edge of the foothills between Lassen National Forest and the south fork of Battle Creek, as well as southeast of the town of Shingleton near the town of Manton.

In the northwestern side of the study area, habitat patches for a number of species, including mountain lion, mountain quail, southern alligator lizard, and spotted towhee, in or near the Whiskeytown-Shasta-Trinity NRA Block are isolated from the foothills by the City of Redding and Shasta Lake. Other species with isolated habitat patches on the western side of the study area that were not captured by habitat blocks or wildlife linkages include acorn woodpecker, coast horned lizard, dusky-footed woodrat, northern pygmy owl and western gray squirrel. Several species have isolated habitat patches on the east side of the study area due to lack of contiguous areas of suitable habitat, including acorn woodpecker, black-tailed jack rabbit, bobcat, California quail, and southern alligator lizard. Connectivity for foothill yellow-legged frog, western pond turtle, and wood duck is limited to riparian areas in the northern region of this study subsection.

Wildlife linkages on the western side of this study subsection have the greatest number of major road crossings, including Highway 5, and State Routes 299 and 273.

The **NSNF Region 2 North subsection** ranges from Butte County south through Nevada, Yuba, and Sutter counties. The western side of this study subsection has extensive agricultural and urban development, in most places extending to the boundary of the foothills ecoregion, including the cities of Marysville, Yuba City, Gridley, Oroville, and Chico. The City of Oroville and adjacent Lake Oroville and its tributaries are a significant barrier to wildlife movement that spans the entire width of the foothills in Butte County. In addition, the cities of Grass Valley, Nevada City, and Paradise pose barriers to movement in the central and eastern foothills. On the eastern side of the study area, natural habitat is fairly continuous and generally well-connected, although extensive logging on the east side of the study area may affect habitat suitability. Several large landscape blocks are found on the east side of the study area including the Plumas and Tahoe National Forests. Wildlife linkages providing habitat for the largest number of focal species are located through the central foothills: between Big Chico Creek and the Plumas National Forest, and near the Spenceville Wildlife Area and Bear River.

Several landscape blocks on the western side of the study area, including the Sacramento National Wildlife Refuge, Gray Lodge Wildlife Area, Sutter Bypass, and the Sutter Buttes, were found to have limited connectivity with blocks in the foothills due to surrounding urban and agricultural development. Habitat patches for acorn woodpecker, southern alligator lizard, spotted towhee, western pond turtle, pallid bat, California kangaroo rat, coast horned lizard, foothill yellow-legged frog, and wood duck in this area were found to be isolated or have limited connectivity with foothill blocks. These patches may become more isolated over time as urbanization around the City of Chico continues.

Some habitat patches within the foothills and on the eastern side of the study area were found to be isolated from neighboring blocks by barriers in the landscape and/or lack of contiguous suitable habitat. Some California ground squirrel habitat patches on the eastern side of the study area were found to be isolated from the foothill blocks by lack of contiguous suitable habitat and by the cities of Nevada City and Grass Valley. Some racer habitat patches near the Lassen National Forest were found to be isolated from foothills habitat blocks by lack of contiguous suitable habitat. Bobcat habitat patches on the east side of the study area are isolated from the foothill blocks by Lake Oroville and the City of Paradise. Habitat connectivity for black bear down the length of Butte County from north to south was found through the Plumas National Forest to the east and not through corridors within the foothills. Connectivity for foothill yellow-legged frog was found to be limited to areas with sufficient river and stream connections.

Wildlife linkages with the greatest number of road crossings are on the western side of the study area between the Sutter Buttes and Spenceville Wildlife Area, crossed by highways 99, 70, and 20; and a connection on the eastern side of the foothills near the town of Grass Valley that is crossed by highways 49, 20, and 174.

The **NSNF Region 2 South subsection** ranges from Placer County south through Calaveras County. The western side of the study subsection is highly developed, including the cities of Sacramento and Elk Grove, and adjacent agricultural areas. The cities of Sacramento, Roseville, Lincoln, Auburn, and surrounding cities along Highway I-80 represent a significant barrier to wildlife movement that extends from west to east across almost the entire study area. Outside of these urban areas, natural habitat within the foothills and on the eastern side of the study area is fairly continuous and generally well-connected. Several large landscape blocks are found on the east side of the study area including the El Dorado and Tahoe National Forests. Wildlife linkages providing habitat for the largest number of focal species are located through the central foothills, including from the Cosumnes River south to the Mokelumne River; between the Mokelumne River and the Antelope Valley Wildlife Area; and south from the Mokelumne River and Bear Mountains to New Melones Lake.

Several landscape blocks on the western side of the study area were found to have limited connectivity with blocks in the foothills due to surrounding urban and agricultural development. Isolated habitat patches on the western side of the study area were found for acorn woodpecker, black-tailed jackrabbit, California ground squirrel, California quail, California thrasher, Cooper's hawk, mule deer, northern pygmy owl, pallid bat, racer, southern alligator lizard, spotted towhee, western gray squirrel, western pond turtle, wood duck, and yellow-billed magpie. The Cosumnes River Ecological Reserve Block, which provides habitat for many of these species, did not connect to any adjacent blocks with a wildlife linkage, although it is connected to adjacent blocks with riparian corridors.

The only focal species for which isolated habitat patches were found within the foothills and to the east were California kangaroo rat, with isolated habitat patches in the central foothills, and gopher snake, which isolated habitat patches on the east side of the study area. Connectivity for foothill yellow-legged frog was found to be limited to areas with sufficient river and stream connections. Habitat connectivity across Highway 80 was found in only three places: the American River riparian corridor within the City of Sacramento, a wildlife linkage just north of the City of Auburn, and two overlapping wildlife linkages just south of the City of Colfax.

Wildlife linkages with the greatest number of major road crossings are those to the north, east, and south of the greater Sacramento area, with road crossings of major highways including Highways 80, 50, 49, 16, 88, 104, and 124.

The **NSNF Region 4 subsection** ranges from Tuolumne County south through Madera County, and into a small area of northern Fresno County. The cities of Merced and Madera are located in the western and southern side of this study subsection, and intensive agricultural development is found along the entire western side of the study area, in some places extending almost to the boundary of the foothills ecoregion. Natural habitat within the foothills and on the eastern side of the study area is fairly continuous and generally well-connected. Several large landscape blocks are found on the east side of the study area including Yosemite National Park and Stanislaus National Forest. Linkages providing habitat for the largest number of focal species are located in the eastern and southeastern part of the subregion as well as in the central foothills between New Melones Lake, the Red Hills, and the Stanislaus National Forest.

The only focal species for which isolated habitat patches were found within the foothills and to the east were two bird species: California thrasher was found to have a few isolated habitat patches on the eastern side of the study area between Stanislaus National Forest and the main foothill blocks; and yellow-billed magpie was found to have isolated habitat patches on the eastern side of the study area near the Airway Beacon Block.

The western part of the foothills in this subregion has little land under conservation protection; very few landscape blocks were identified in the western foothills, and no landscape blocks were identified on the southern end of the foothills. Several landscape blocks were identified in the Central Valley on the western side of the study area, although for a number of species these blocks were found to be isolated from the foothills blocks due to agricultural and urban development. Isolated habitat patches on the western side of the study area were found for acorn woodpecker, dusky-footed woodrat, Heermann's kangaroo rat, pallid bat, spotted towhee, western pond turtle, and wood duck.

Linkages with the greatest number of major road crossings, include one on the western side that crosses highways 4, 120, and 132, and several on the southern end of the study area crossing highways 99, 49 and 41.

5.2 Assessing and comparing wildlife linkages, land facets, and riparian corridors

The linkages we built offer hypotheses for movement pathways, and may be improved over time as our understanding of actual species movement in the landscape increases based on field data. Here we developed three types of corridors: wildlife corridors, riparian corridors, and land facet corridors. Each of these provides a slightly different view of movement in the landscape, and requires different levels of data and analysis for development.

Wildlife linkages developed using habitat suitability models are based on the assumption that ecological attributes of the landscape, most notably land cover (i.e., vegetation or habitat type), determine the paths species will take when moving through the landscape. This assumption can be tested by recording where species are moving in the landscape using technology such as camera traps or GIS tracking collars, and analyzing whether species are more likely to use modeled corridor habitat than the matrix. A project is underway in our Region 2 field office to use camera traps and field transects to evaluate species use of our NSNF modeled corridors.

Wildlife linkages are the most data-intensive of the three corridor types we modeled, requiring extensive information about the species to be modeled, an accurate land cover dataset for the study area, as well as significant GIS and computer resources for analysis. Many decisions must be made including which focal species to model, how to develop the habitat suitability models, and rules for which corridors to include in the final linkage. The focal species list is limited by the availability of sufficient data and life history information: the estimated home range size and dispersal distance must be known, as well as information about habitat use for the development of expert opinion habitat suitability models, or enough occurrence location data must be available for statistical modeling. Habitat suitability models must be developed for each species, and a patch analysis and least-cost corridor analysis implemented. Collaboration with wildlife species experts who can provide species information and review model outputs is a key component of developing wildlife linkages.

The land facets methodology was developed to capture potential movement corridors that species may follow as they adapt to climate change (Brost 2010). In addition, land facets may capture species movement patterns that are influenced by physical attributes of the landscape, such as those of species that tend to travel along canyons or ridgelines. Camera traps or GIS tracking collars can be used to assess whether species are currently using land facet corridors. Testing how land facets will be used by species in a changing climate is more challenging, because we have no future data with which to evaluate the models. There may be opportunities to test whether land facets were used as movement corridors based on species location data over the course of past climate change events. While the land facet analysis requires significant GIS expertise and computer resources to implement, there are fewer pieces of data needed compared to the wildlife linkage analysis: the land facets analysis requires only a digital elevation model of the study area, and review by an expert familiar with the topography landscape.

Riparian corridors incorporate both land cover and physical landscape attributes. Previous studies have found riparian corridors to be important for species movement, particularly in highly modified landscapes where they may be the only remaining contiguous swaths of natural habitat that provide cover, water, and food for wildlife (Hilty and Merlander 2004). Riparian corridors are essential for aquatic turtles, reptiles and amphibians (Fischer and Fischenich 2000). In addition, riparian corridors serve multiple valuable ecological functions such as providing habitat and connectivity for wildlife and fish species, preserving water quality, and providing flood control (Naiman et al. 1992). Many riparian zones have been degraded to the point they no longer serve these ecological functions, but they are often good candidates for restoration (Fischer and Fischenich 2000). Delineation of riparian corridors requires information on the location of rivers and streams, and ideally also an accurate vegetation map showing the location of riparian habitat areas. Sophisticated GIS models are not required for the development of riparian corridors.

Modeling wildlife corridors, land facets, and riparian corridors within the NSNF ecoregion allowed us to compare the results of the three methodologies. Wildlife linkages rely heavily on species-specific wildlife data, while no information about wildlife species is required when developing either land facets or riparian corridors. The strong emphasis on wildlife species data in the development of wildlife linkages, while more data-intensive and therefore more costly to implement than the other methodologies, does result in wildlife linkages that better capture wildlife habitat in the ecoregion overall: the corridors captured 50% of the total mapped suitable wildlife habitat in the ecoregion, while riparian corridors captured 20% and land facet corridors 25%. This may be, in part, because the wildlife linkages encompassed more area (1,143,695.9 ha) than the land facets (512,359 ha) and riparian corridors (733,607 ha). However, the wildlife linkages captured 50% or more of the critical habitat of 10 out of 17 listed species in the ecoregion, while riparian corridors captured 50% or more of the habitat for only 1 listed species, and the land facet corridors for none. The wildlife linkages offer an important tool for conservation planning, representing areas important for wildlife that also provide habitat connectivity in the landscape.

Land facets are a relatively new concept and to date no studies of wildlife use of land facets have been published. If wildlife species are found to use land facet corridors for movement in present climate conditions, the ability of land facets to capture movement corridors for current and potential future climates may increase their value for conservation planning.

Because riparian areas serve multiple ecological functions, they are often ranked as high priority in conservation prioritization projects. Our riparian corridors intersected with TNC priority areas 27% of the time, while the wildlife linkages intersected with TNC priority areas 18% of the time and land facet corridors only 10%. Riparian corridors offer an important tool for conservation planning, representing areas that are important for wildlife and serve multiple ecological functions, although they provide species habitat and connectivity for only a subset of species in the study area.

5.3 Linkages: Not just for wildlife

Due to their sessile nature, plants are corridor dwellers that may move through a corridor very slowly over multiple generations. Rare vegetation communities are unique assemblages of plants that may also have conservation status and protection. Plants or vegetation communities may be included as corridor dwellers in a linkage analysis. However, because movement of plant species is generally limited, inclusion of specific plant species may be more appropriate in a conservation plan that prioritizes habitat for species of concern, rather than a connectivity analysis meant to address movement across the landscape. We did not include plants or vegetation communities specifically in the NSNF connectivity analysis, but did find that all rare vegetation communities mapped in the ecoregion were captured within the final landscape blocks, wildlife linkages, or riparian corridors. Plant species are expected to move as climate conditions change. Because plant distributions are often strongly influenced by topographic position, the potential movement paths of plants as the climate changes may be best captured by land facet corridors.

5.4 Prioritizing linkages for conservation

This analysis resulted in the identification 246 wildlife linkages, 280 riparian corridors, and 169 land facet corridors in the NSNF ecoregion. In addition, the project developed maps of suitable habitat and core habitat areas for 30 focal species representative of the ecoregion. The results provide information that can be used in conservation planning and prioritization.

Some general recommendations for corridor prioritization include (Fischer and Fischenich 2000):

- Corridors that maintain or restore natural connectivity are better than those that link areas historically unconnected
- Continuous corridors are better than fragmented corridors
- Wider corridors are better than narrow corridors
- Riparian corridors may be more valuable than other types of corridors because of habitat heterogeneity, and availability of food and water
- Several corridor connections are better than a single connection
- Structurally diverse corridors are better than structurally simple corridors

The NSNF linkages may be prioritized a number of ways depending on the goals of the conservation project, and a large attribute table provides information on each linkage that can be used for prioritization. Examples include:

- The landscape blocks the linkage connects
- The type of landcover present in the linkage
- The number of species for which the linkage provides habitat and connectivity
- The amount of habitat the linkage provides for a specific species
- The number of rare species the linkage provides habitat for
- Areas of overlap between wildlife linkages, riparian corridors and land facet corridors

6 Literature Cited

Beier, P., and B. Brost. 2010. Use of Land Facets to Plan for Climate Change: Conserving the Arenas, Not the Actors. Conservation Biology **24**:701-710.

Beier, P., D. R. Majka, and J. S. Jenness. 2007. Conceptual steps for designing wildlife corridors.

Beier, P., D. R. Majka, and S. L. Newell. 2009. Uncertainty analysis of least-cost modeling for designing wildlife linkages. Ecological Applications **19**:2067-2077.

Beier, P., D. R. Majka, and W. Spencer. 2008. Forks in the Road: Choices in Procedures for Designing Wildland Linkages. Conservation Biology **22**:836-851.

Beier, P., and R. F. Noss. 1998. Do Habitat Corridors Provide Connectivity? Conservation Biology **12**:1241-1252.

Beier, P., K. Penrod, C. Luke, W. Spencer, and C. Cabanero. 2006. South Coast Missing Linkages: restoring connectivity to wildlands in the largest metropolian ara in the United States.*in* K. R. Crooks and M. A. Sanjayan, editors. Connecitivty Conservation. Cambridge University Press, Cambridge, UK.

Brost, B. 2010. Use of land facets to design conservation corridors: Conserving the arenas, not the actors. Northern Arizona University, Flagstaff, AZ.

CDFW, and GIC. 2013. Fine-Scale Riparian Vegetation Mapping of the Central Valley Flood Protection Plan Area Final Report. California Department of Fish and Wildlife, Vegetation Classification and Mapping Program and Geographical Information Center, California State University, Chico, Sacramento, California.

CNDDB. 2014. California Natural Diversity Database. California Department of Fish and Wildlife, Sacramento, California.

Crooks, K. R. 2002. Relative sensitivies of mammalian carnivores to habitat fragmentation. Conservation Biology **16**:488-502.

CWHR. 2008. California Wildlife Habitat Relationships. California Department of Fish and Wildlife, California Interagency Wildlife Task Group, Sacramento, CA.

Davis, F. W., C. Costello, and D. M. Stoms. 2006. Efficient conservation in a utility-maximization framework. Ecology and Society **11 (1): 33**:http://www.ecologyandsociety.org/vol11/iss11/art33/main.html.

Davis, F. W., D. M. Stoms, C. Costello, E. Machado, J. Metz, R. Gerrard, S. Andelman, H. Regan, and R. Church. 2003. A framework for setting land conservation priorities using multi-criteria scaoring and an optimal fund allocation strategy., National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA, USA.

Elith, J., and C. H. Graham. 2009. Do they? How do they? WHY do they differ? on finding reasons for differing performances of species distribution models. Ecography **32**:66-77.

Epps, C. W., J. D. Wehausen, V. C. Bleich, S. G. Torres, and J. S. Brashares. 2007. Optomizing dispersal and corridor models using landscape genetics. Journal of Applied Ecology **44**:714-724.

ESRI. 2012. ArcGIS Desktop: Release 10.1. Environmental Systems Research Insititute, Redlands, California.

Fielding, A. H., and J. F. Bell. 1997. A review of methods for the assessment of prediction erros in conservation presence/absence models. Environmental Conservation **24**:38-49.

Fischer, R. A., and J. C. Fischenich. 2000. Design recommendations for riparian corridors and vegetated buffer strips. US Army Engineer Research and Development Center, Vicksburg, MS.

Franklin, J. 2009. Mapping species distributions: spatial inference and prediction. Cambridge University Press, Cambridge, UK.

FRAP. 2010. California's Forests and Rangelands: 2010 Assessment. Fire and Resource Assessment Program, California Department of Forestry and Fire Protection. Sacramento, California.

Freeman, E. A., and G. Moisen. 2008. Presence absence: an R package for presence-absence analysis. Journal of Statistical Software **23**:1-31.

Hanley, J. A., and B. J. McNeil. 1982. The meaning and use of the Area under a Receiver Operating Characteristic (ROC) Curve. Radiology **143**:29-36.

Hijmans, R. J., S. J. Phillips, J. Leathwick, and J. Elith. 2011. R package 'dismo' for species distribution modeling. The R Project for Statistical Computing.

Hilty, J., and A. M. Merenlender. 2004. Use of riparian corridors and vineyards by mammalian predators in Northern California. Conservation Biology **18**:126-135.

Huber, P. R., F. Shilling, J. H. Thorne, and S. E. Greco. 2012. Municipal and regional habitat connectivity planning. Landscape and Urban Planning **105**:15-26.

Jennings, C. W., C. Gutierres, W. Bryant, G. Saucendo, and C. Wills. 2010. Geologic map of California: California Geologica Survey, Geologic Data Map No. 2, map scale 1:750,00.

Lobo, J. M., A. Jimenez-Valverde, and R. Real. 2008. AUC: a misleading measure of the performance of predictive distribution models. Global Ecology and Biogeography **17**:145-151.

Luke, C., K. Penrod, C. Cabanero, P. Beier, W. Spencer, and S. Shapiro. 2004. A linkage design for Santa Ana-Palomar Mountain connection., San Diego State University Field Station Programs, San Diego, CA

Menke, J., E. Reyes, D. Johnson, J. Evens, K. Sikes, T. Keeler-Wolf, and R. Yacoub. 2011. Northern Sierra Nevada Foothills Vegetation Project: Vegetation Mapping Report California Department of Fish and Game, Sacramento, California.

Naiman, R. J., T. J. Beechie, L. E. Benda, D. R. Berg, P. A. Bisson, L. G. MacDonald, M. D. O'Connor, P. L. Olson, and E. A. Steel. 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest coastal ecoregion.*in* R. J. Naiman, editor. Watershed Management: balancing sustainability and environmental change. Springer-Verlag, New York, NY, USA.

Ordenana, M. A., K. R. Crooks, E. E. Boydston, R. N. Fisher, L. M. Lyren, S. Siudyla, C. D. Haas, S. Harris, S. A. Hathaway, G. M. Turschak, A. K. Miles, and D. Van Vuren. 2010. Effects of ubanization on carnivore species distribution and richness. Journal of Mammology **91**:1322-1331.

Penrod, K., P. Beier, E. Garding, and C. Cabanero. 2012. A linkage network for the California Deserts. Science and Collaboration for Connected Wildlands, Fair Oaks, CA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2004a. A linkage design for the San Gabrel-Castaic connection., South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005a. A linkage design for San Bernardino-Little San Berardino connection., South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005b. A linkage design for the San Bernardino-Granite connect. South Coast Wildlands, Idyllwild, Ca, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005c. A linkage design for the San Bernardino-San Jacinto connection. South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005d. A linkage design for the Sierra Madre-Castaic connection., South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006a. A linkage design for the Palomar-San Jacinto/Santa Rosa Connection. South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006b. A linkage design for the Penisular-Borrego connection. South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, S. Loe, and K. Meyer. 2004b. South Coast Missing Linkages Project: A Linkage Desing for the San Gabriel-San Bernardino Connection. South Coast Wildlands, Idyllwild, CA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, and C. Paulman. 2008a. A linkage design for the JoshuaTree-Twentynine Palms connection. South Coast Wildlands, Fair Oaks, CA, USA.

Penrod, K., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, R. M. Sauvajot, S. P. D. Riley, and D. Kamradt. 2006c. A linkage design for the Santa Monica-Sierra Madre connection., South Coast Wildlands, Idyllwild, CA, USA.

Penrod, K., C. Cabanero, C. Luke, P. Beier, W. Spencer, and E. Rubin. 2003. A linkage design for the Tehachapi connection., South Coast Wildlands, Monrovia, CA.

Penrod, K., E. Garding, C. Paulman, P. Beier, S. Weiss, N. Schaefer, R. Branciforte, and K. Gaffney. 2013. Critial Linkages: Bay Area and Beyond. Science and Collaboration for Connected Wildlands, Fair Oaks, CA.

Penrod, K., R. Hunter, and M. Merrifield. 2001. Missing Linkages: Restoring Connectivity to the California Landscape, Conference Proceedings. Co-sponsored by California Wilderness Coalition, The Nature Conservancy, U.S. Geological Survey, Center for Reproduction of Endangered Species and California State Parks.

Penrod, K. C., C. Cabanero, P. Beier, C. Luke, W. Spencer, E. Rubin, and C. Paulman. 2008b. A linkage design for the Joshua Tree-Twentynine Palms Connection. South Coast Wildlands, Fair Oaks, CA.

Phillips, S. J., R. P. Anderson, and R. E. Schapire. 2006. Maximum entropy modeling of species geographic distributions. Ecological Modelling **190**:231-259.

R-project. 2013. R: A language and environment for statistical computing. R Core Team: R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Spencer, W., P. Beier, K. Penrod, K. Winters, C. Paulman, H. Rustigian-Romsos, J. Strittholt, M. Parisi, and A. Pettler. 2010. California essential habitat connectivity project: A strategy for conserving a connected California. California Department of Transportation, California Department of Fish and Game and Federal Highways Administration, Sacramento, CA.

Van Vuren, D. 1998. Mammalian dispersal and reserve design. Pages 369-393 *in* T. M. Caro, editor. Behavioral ecology and conservation biology. Oxford University Press, New York.

Zeiner, D. C., W. F. J. Laudenslayer, K. E. Mayer, and M. White. 1990. California's Wildlife. State of California, The Resources Agency, Department of Fish and Game, Sacramento, California.

Appendix A. State and federally-listed species residing in the northern Sierra Nevada foothills ecoregion (CNDDB 2014). Status definitions: California State-Endangered (SE), State-Threatened (ST), State-Rare (SR), State Candidate-Threatened (SCT); USFWS Federal-Threatened (FT), Federal-Endangered (FE), or Federal-Proposed-Threatened (FPT).

Scientific Name	**Common Name**	**Status**
Ambystoma californiense	California tiger salamander	ST, FT
Arctostaphylos myrtifolia	Ione manzanita	FT
Branchinecta lynchi	vernal pool fairy shrimp	FT
Brodiaea pallida	Chinese Camp brodiaea	SE, FT
Buteo swainsoni	Swainson's hawk	ST
Calyptridium pulchellum	Mariposa pussypaws	FT
Calystegia stebbinsii	Stebbins' morning-glory	SE, FE
Castilleja campestris var. succulenta	succulent owl's-clover	SE, FT
Ceanothus roderickii	Pine Hill ceanothus	SR, FE
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT
Eryngium racemosum	Delta button-celery	SE
Euphorbia hooveri	Hoover's spurge	FT
Fremontodendron decumbens	Pine Hill flannelbush	SR, FE
Galium californicum ssp. sierrae	El Dorado bedstraw	SR, FE
Gratiola heterosepala	Boggs Lake hedge-hyssop	SE
Haliaeetus leucocephalus	bald eagle	SE
Hydromantes brunus	limestone salamander	ST
Laterallus jamaicensis coturniculus	California black rail	ST
Lepidurus packardi	vernal pool tadpole shrimp	FE
Limnanthes floccosa ssp. californica	Butte County meadowfoam	SE, FE
Lupinus citrinus var. deflexus	Mariposa lupine	ST
Oncorhynchus mykiss irideus	steelhead - Central Valley DPS	FT
Oncorhynchus tshawytscha	chinook salmon - Sacramento River winter-run ESU	SE, FE
Oncorhynchus tshawytscha	chinook salmon - Central Valley spring-run ESU	ST, FT
Orcuttia tenuis	slender Orcutt grass	SE, FT
Packera layneae	Layne's ragwort	SR, FT
Pekania pennanti	fisher - West Coast DPS	SCT, FPT
Pseudobahia bahiifolia	Hartweg's golden sunburst	SE, FE
Rana draytonii	California red-legged frog	FT
Riparia riparia	bank swallow	ST
Thamnophis gigas	giant garter snake	ST, FT
Tuctoria greenei	Greene's tuctoria	SR, FE
Verbena californica	Red Hills vervain	ST, FT
Vireo bellii pusillus	least Bell's vireo	SE, FE
Vulpes macrotis mutica	San Joaquin kit fox	ST, FE

Appendix B. Processing steps for developing the perennial stream layer

The stream/river dataset was extracted from NHD as follows. First, a feature named 'StreamRiver' was extracted from the 'NHDFlowline' vector dataset. A code 46006 was then used to extract perennial rivers and streams from the 'StreamRiver' dataset. However, this step resulted in a stream and river layer with many small segments that were not necessarily continuous. In order to reduce the number of segments and identify complete stream/river lines, we intersected the perennial rivers and streams layer with a Department statewide streams layer ('CA_Streams_Statewide') using the 'Select by Location' tool in ArcMap ('CA_Streams_Statewide' layer as target layer and the streams and rivers layer we extracted from NHD as a target layer). Second, we extracted a feature named 'ArtificialPath' from the 'NHDFlowline' vector dataset. Artificial paths represent the flow of water into, through, and out of features, and represent some large rivers (i.e., when a river is wide enough to be delineated as a polygon, the "artificial path" represents the flowline through the center of that polygon). They ensure that the hydrographic network is complete. We selected only those artificial paths with Geographic Names Information System (GNIS) names, with the assumption that artificial path features without names are "very minor streams, only of use to hydrologist" (http://nhd.usgs.gov). Next we used the same method we implemented for streams and rivers in order to remove small segments and have complete lines. The artificial path dataset is not coded to discriminate between perennial and intermittent paths. As a result, artificial paths that intersected with perennial streams and rivers were selected to represent permanent artificial paths. Then, the perennial stream and river layer and the artificial paths layer were merged into one dataset.

Appendix C. California Wildlife Habitat Relationship habitat suitability scores (C WHR 2008) for bobcat, California ground squirrel, gopher snake, gray fox, pallid bat, racer, and spotted towhee. Scores range from 1-100, with 100 being the highest suitability. Habitats with score 0 (no suitability) are not listed.

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Alpine-Dwarf Shrub			66	Jeffrey Pine	1		44	Palm Oasis			44
Agriculture			23	Jeffrey Pine	2	D	66	Ponderosa Pine	1		44
Annual Grassland		P	44	Jeffrey Pine	2	M	100	Ponderosa Pine	2	D	66
Annual Grassland		S	44	Jeffrey Pine	2	P	100	Ponderosa Pine	2	M	100
Annual Grassland			44	Jeffrey Pine	2	S	100	Ponderosa Pine	2	P	100
Alkali Desert Scrub			55	Jeffrey Pine	3	D	55	Ponderosa Pine	2	S	100
Aspen	1		44	Jeffrey Pine	3	M	66	Ponderosa Pine	2		100
Aspen	2	D	66	Jeffrey Pine	3	P	100	Ponderosa Pine	3	D	55
Aspen	2	M	100	Jeffrey Pine	3	S	100	Ponderosa Pine	3	M	66
Aspen	2	P	100	Jeffrey Pine	3		66	Ponderosa Pine	3	P	100
Aspen	2	S	100	Jeffrey Pine	4	D	33	Ponderosa Pine	3	S	100
Aspen	3	D	55	Jeffrey Pine	4	M	55	Ponderosa Pine	3		66
Aspen	3	M	66	Jeffrey Pine	4	P	66	Ponderosa Pine	4	D	33
Aspen	3	P	100	Jeffrey Pine	4	S	89	Ponderosa Pine	4	M	55
Aspen	3	S	100	Jeffrey Pine	4		55	Ponderosa Pine	4	P	66
Aspen	4	D	33	Jeffrey Pine	5	D	33	Ponderosa Pine	4	S	89
Aspen	4	M	55	Jeffrey Pine	5	M	33	Ponderosa Pine	4		55
Aspen	4	P	66	Jeffrey Pine	5	P	55	Ponderosa Pine	5	D	33
Aspen	4	S	89	Jeffrey Pine	5	S	66	Ponderosa Pine	5	M	33
Aspen	5	D	33	Jeffrey Pine	5		33	Ponderosa Pine	5	P	55
Aspen	5	M	33	Joshua Tree	1		44	Ponderosa Pine	5	S	66
Bitterbrush			89	Joshua Tree	2	D	33	Ponderosa Pine	5		33
Blue Oak-Foothill Pine	1		44	Joshua Tree	2	M	33	Ponderosa Pine	6		33
Blue Oak-Foothill Pine	2	D	66	Joshua Tree	2	P	33	Redwood	1		44
Blue Oak-Foothill Pine	2	M	100	Joshua Tree	2	S	66	Redwood	2	D	66
Blue Oak-Foothill Pine	2	P	100	Joshua Tree	3	D	33	Redwood	2	M	100
Blue Oak-Foothill Pine	2	S	100	Joshua Tree	3	M	33	Redwood	2	P	100

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Blue Oak-Foothill Pine	3	D	55	Joshua Tree	3	P	33	Redwood	2	S	100
Blue Oak-Foothill Pine	3	M	66	Joshua Tree	3	S	66	Redwood	3	D	55
Blue Oak-Foothill Pine	3	P	100	Joshua Tree	4	D	33	Redwood	3	M	66
Blue Oak-Foothill Pine	3	S	100	Joshua Tree	4	M	33	Redwood	3	P	100
Blue Oak-Foothill Pine	4	D	33	Juniper	1		44	Redwood	3	S	100
Blue Oak-Foothill Pine	4	M	55	Juniper	2	M	100	Redwood	4	D	33
Blue Oak-Foothill Pine	4	P	66	Juniper	2	P	100	Redwood	4	M	55
Blue Oak-Foothill Pine	4	S	89	Juniper	2	S	100	Redwood	4	P	66
Blue Oak-Foothill Pine	5	D	33	Juniper	2		100	Redwood	4	S	89
Blue Oak-Foothill Pine	5	M	33	Juniper	3	D	55	Redwood	5	D	0
Blue Oak-Foothill Pine	5	P	55	Juniper	3	M	66	Redwood	5	M	33
Blue Oak-Foothill Pine	5	S	66	Juniper	3	P	100	Redwood	5	P	55
Blue Oak Woodland	1		44	Juniper	3	S	100	Redwood	5	S	66
Blue Oak Woodland	2	D	66	Juniper	3		66	Red Fir	1		44
Blue Oak Woodland	2	M	100	Juniper	4	D	33	Red Fir	2	D	33
Blue Oak Woodland	2	P	100	Juniper	4	M	55	Red Fir	2	M	66
Blue Oak Woodland	2	S	100	Juniper	4	P	66	Red Fir	2	P	77
Blue Oak Woodland	3	D	55	Juniper	4	S	89	Red Fir	2	S	100
Blue Oak Woodland	3	M	66	Juniper	4		55	Red Fir	2		66
Blue Oak Woodland	3	P	100	Juniper	5	D	33	Red Fir	3	D	33
Blue Oak Woodland	3	S	100	Juniper	5	M	33	Red Fir	3	M	66
Blue Oak Woodland	4	D	33	Juniper	5	P	55	Red Fir	3	P	77
Blue Oak Woodland	4	M	55	Juniper	5	S	66	Red Fir	3	S	100
Blue Oak Woodland	4	P	66	Juniper	5		33	Red Fir	3		66
Blue Oak Woodland	4	S	89	Klamath Mixed Conifer	1		44	Red Fir	4	D	33
Blue Oak Woodland	5	D	33	Klamath Mixed Conifer	2	D	66	Red Fir	4	M	33
Blue Oak Woodland	5	M	33	Klamath Mixed Conifer	2	M	100	Red Fir	4	P	44
Blue Oak Woodland	5	P	55	Klamath Mixed Conifer	2	P	100	Red Fir	4	S	66

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Blue Oak Woodland	5	S	66	Klamath Mixed Conifer	2	S	100	Red Fir	4		33
Coastal Oak Woodland	1		44	Klamath Mixed Conifer	2		100	Red Fir	5	D	33
Coastal Oak Woodland	2	D	66	Klamath Mixed Conifer	3	D	55	Red Fir	5	M	33
Coastal Oak Woodland	2	M	100	Klamath Mixed Conifer	3	M	66	Red Fir	5	P	33
Coastal Oak Woodland	2	P	100	Klamath Mixed Conifer	3	P	100	Red Fir	5	S	44
Coastal Oak Woodland	2	S	100	Klamath Mixed Conifer	3	S	100	Red Fir	5		33
Coastal Oak Woodland	3	D	55	Klamath Mixed Conifer	3		66	Red Fir	6		33
Coastal Oak Woodland	3	M	66	Klamath Mixed Conifer	4	D	33	Rice			0
Coastal Oak Woodland	3	P	100	Klamath Mixed Conifer	4	M	55	Riverine			0
Coastal Oak Woodland	3	S	100	Klamath Mixed Conifer	4	P	66	Subalpine Conifer	1		44
Coastal Oak Woodland	4	D	33	Klamath Mixed Conifer	4	S	89	Subalpine Conifer	2	D	33
Coastal Oak Woodland	4	M	55	Klamath Mixed Conifer	4		55	Subalpine Conifer	2	M	66
Coastal Oak Woodland	4	P	66	Klamath Mixed Conifer	5	D	33	Subalpine Conifer	2	P	77
Coastal Oak Woodland	4	S	89	Klamath Mixed Conifer	5	M	33	Subalpine Conifer	2	S	100
Coastal Oak Woodland	5	D	33	Klamath Mixed Conifer	5	P	55	Subalpine Conifer	2		66
Coastal Oak Woodland	5	M	33	Klamath Mixed Conifer	5	S	66	Subalpine Conifer	3	D	33
Coastal Oak Woodland	5	P	55	Klamath Mixed Conifer	5		33	Subalpine Conifer	3	M	66
Coastal Oak Woodland	5	S	66	Lodgepole Pine	1		44	Subalpine Conifer	3	P	77
Closed-Cone Pine-Cypress	1		44	Lodgepole Pine	2	D	33	Subalpine Conifer	3	S	100
Closed-Cone Pine-Cypress	2	D	33	Lodgepole Pine	2	M	66	Subalpine Conifer	3		66
Closed-Cone Pine-Cypress	2	M	66	Lodgepole Pine	2	P	77	Subalpine Conifer	4	D	33
Closed-Cone Pine-Cypress	2	P	77	Lodgepole Pine	2	S	100	Subalpine Conifer	4	M	33
Closed-Cone Pine-Cypress	2	S	100	Lodgepole Pine	2		66	Subalpine Conifer	4	P	44
Closed-Cone Pine-Cypress	3	D	33	Lodgepole Pine	3	D	33	Subalpine Conifer	4	S	66
Closed-Cone Pine-Cypress	3	M	66	Lodgepole Pine	3	M	66	Subalpine Conifer	4		33
Closed-Cone Pine-Cypress	3	P	77	Lodgepole Pine	3	P	77	Subalpine Conifer	5	D	33
Closed-Cone Pine-Cypress	3	S	100	Lodgepole Pine	3	S	100	Subalpine Conifer	5	M	33
Closed-Cone Pine-Cypress	4	D	33	Lodgepole Pine	3		66	Subalpine Conifer	5	P	33

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Closed-Cone Pine-Cypress	4	M	33	Lodgepole Pine	4	D	33	Subalpine Conifer	5	S	44
Closed-Cone Pine-Cypress	4	P	44	Lodgepole Pine	4	M	33	Subalpine Conifer	5		33
Closed-Cone Pine-Cypress	4	S	66	Lodgepole Pine	4	P	44	Subalpine Conifer	6		33
Closed-Cone Pine-Cypress	5	D	33	Lodgepole Pine	4	S	66	Saline Emergent Wetland			44
Closed-Cone Pine-Cypress	5	M	33	Lodgepole Pine	4		33	Sagebrush			89
Closed-Cone Pine-Cypress	5	P	33	Lodgepole Pine	5	D	33	Sierran Mixed Conifer	1		44
Closed-Cone Pine-Cypress	5	S	44	Lodgepole Pine	5	M	33	Sierran Mixed Conifer	2	D	66
Chamise-Redshank Chaparral		S	55	Lodgepole Pine	5	P	33	Sierran Mixed Conifer	2	M	100
Chamise-Redshank Chaparral		M	89	Lodgepole Pine	5	S	44	Sierran Mixed Conifer	2	P	100
Cropland			23	Lodgepole Pine	6		33	Sierran Mixed Conifer	2	S	100
Coastal Scrub			89	Low Sage			89	Sierran Mixed Conifer	2		100
Douglas Fir	1		44	Mixed Chaparral		D	89	Sierran Mixed Conifer	3	D	55
Douglas Fir	2	D	66	Mixed Chaparral		M	89	Sierran Mixed Conifer	3	M	66
Douglas Fir	2	M	100	Mixed Chaparral		P	77	Sierran Mixed Conifer	3	P	100
Douglas Fir	2	P	100	Mixed Chaparral		S	55	Sierran Mixed Conifer	3	S	100
Douglas Fir	2	S	100	Montane Chaparral		S	55	Sierran Mixed Conifer	3		66
Douglas Fir	3	D	55	Montane Chaparral		M	89	Sierran Mixed Conifer	4	D	33
Douglas Fir	3	M	66	Montane Hardwood-Conifer	1		44	Sierran Mixed Conifer	4	M	55

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Douglas Fir	3	P	100	Montane Hardwood-Conifer	2	D	66	Sierran Mixed Conifer	4	P	66
Douglas Fir	3	S	100	Montane Hardwood-Conifer	2	M	100	Sierran Mixed Conifer	4	S	89
Douglas Fir	4	D	33	Montane Hardwood-Conifer	2	P	100	Sierran Mixed Conifer	4		55
Douglas Fir	4	M	55	Montane Hardwood-Conifer	2	S	100	Sierran Mixed Conifer	5	D	33
Douglas Fir	4	P	66	Montane Hardwood-Conifer	3	D	55	Sierran Mixed Conifer	5	M	33
Douglas Fir	4	S	89	Montane Hardwood-Conifer	3	M	66	Sierran Mixed Conifer	5	P	55
Douglas Fir	5	D	33	Montane Hardwood-Conifer	3	P	100	Sierran Mixed Conifer	5	S	66
Douglas Fir	5	M	33	Montane Hardwood-Conifer	3	S	100	Sierran Mixed Conifer	5		33
Douglas Fir	5	P	55	Montane Hardwood-Conifer	4	D	33	Sierran Mixed Conifer	6		55
Douglas Fir	5	S	66	Montane Hardwood-Conifer	4	M	55	Urban			0
Douglas Fir	6		55	Montane Hardwood-Conifer	4	P	66	Vineyard			23
Dryland Grain Crops			23	Montane Hardwood-Conifer	4	S	89	Valley Oak Woodland	2	D	66
Deciduous Orchard			12	Montane Hardwood-Conifer	5	D	33	Valley Oak Woodland	2	M	100
Desert Riparian	2	D	55	Montane Hardwood-Conifer	5	M	33	Valley Oak Woodland	2	P	100
Desert Riparian	2	M	66	Montane Hardwood-Conifer	5	P	55	Valley Oak Woodland	2	S	100
Desert Riparian	2	P	100	Montane Hardwood-Conifer	5	S	66	Valley Oak Woodland	3	D	55

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Desert Riparian	2	S	100	Montane Hardwood-Conifer	6		55	Valley Oak Woodland	3	M	66
Desert Riparian	3	D	55	Montane Hardwood	1		44	Valley Oak Woodland	3	P	100
Desert Riparian	3	M	55	Montane Hardwood	2	D	66	Valley Oak Woodland	3	S	100
Desert Riparian	3	P	66	Montane Hardwood	2	M	100	Valley Oak Woodland	4	D	33
Desert Riparian	3	S	100	Montane Hardwood	2	P	100	Valley Oak Woodland	4	M	55
Desert Riparian	4	D	55	Montane Hardwood	2	S	100	Valley Oak Woodland	4	P	66
Desert Riparian	4	M	55	Montane Hardwood	2		100	Valley Oak Woodland	4	S	89
Desert Riparian	4	P	66	Montane Hardwood	3	D	55	Valley Oak Woodland	4		55
Desert Riparian	4	S	100	Montane Hardwood	3	M	66	Valley Oak Woodland	5	D	33
Desert Riparian	5	D	55	Montane Hardwood	3	P	100	Valley Oak Woodland	5	M	33
Desert Riparian	5	M	55	Montane Hardwood	3	S	100	Valley Oak Woodland	5	P	55
Desert Riparian	5	P	66	Montane Hardwood	3		66	Valley Oak Woodland	5	S	66
Desert Riparian	5	S	100	Montane Hardwood	4	D	33	Valley Oak Woodland	5		33
Desert Scrub			55	Montane Hardwood	4	M	55	Valley Oak Woodland	6		33
Desert Succulent Shrub			55	Montane Hardwood	4	P	66	Valley Foothill Riparian	1		44
Desert Wash			66	Montane Hardwood	4	S	89	Valley Foothill Riparian	2	D	66

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Evergreen Orchard		S	12	Montane Hardwood	4		55	Valley Foothill Riparian	2	M	100
Eastside Pine	1		44	Montane Hardwood	5	D	33	Valley Foothill Riparian	2	P	100
Eastside Pine	2	D	66	Montane Hardwood	5	M	33	Valley Foothill Riparian	2	S	66
Eastside Pine	2	M	100	Montane Hardwood	5	P	55	Valley Foothill Riparian	2		100
Eastside Pine	2	P	100	Montane Hardwood	5	S	66	Valley Foothill Riparian	3	D	55
Eastside Pine	2	S	100	Montane Hardwood	5		33	Valley Foothill Riparian	3	M	66
Eastside Pine	3	D	55	Montane Hardwood	6		55	Valley Foothill Riparian	3	P	100
Eastside Pine	3	M	66	Montane Riparian	1		44	Valley Foothill Riparian	3	S	66
Eastside Pine	3	P	100	Montane Riparian	2	D	66	Valley Foothill Riparian	3		66
Eastside Pine	3	S	100	Montane Riparian	2	M	100	Valley Foothill Riparian	4	D	33
Eastside Pine	4	D	33	Montane Riparian	2	P	100	Valley Foothill Riparian	4	M	55
Eastside Pine	4	M	55	Montane Riparian	2	S	100	Valley Foothill Riparian	4	P	66
Eastside Pine	4	P	66	Montane Riparian	2		100	Valley Foothill Riparian	4	S	89
Eastside Pine	4	S	89	Montane Riparian	3	D	55	Valley Foothill Riparian	4		55
Eastside Pine	5	D	33	Montane Riparian	3	M	66	Valley Foothill Riparian	5	D	33
Eastside Pine	5	M	33	Montane Riparian	3	P	100	Valley Foothill Riparian	5	M	33

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Eastside Pine	5	P	55	Montane Riparian	3	S	100	Valley Foothill Riparian	5	P	55
Eastside Pine	5	S	66	Montane Riparian	3		66	Valley Foothill Riparian	5	S	66
Eucalyptus	2	D	33	Montane Riparian	4	D	33	Valley Foothill Riparian	5		33
Eucalyptus	2	M	33	Montane Riparian	4	M	55	Valley Foothill Riparian	6		33
Eucalyptus	2	P	33	Montane Riparian	4	P	66	Water			0
Eucalyptus	2	S	33	Montane Riparian	4	S	89	White Fir	1		44
Eucalyptus	3	D	33	Montane Riparian	4		55	White Fir	2	D	66
Eucalyptus	3	M	33	Montane Riparian	5	D	33	White Fir	2	M	100
Eucalyptus	3	P	33	Montane Riparian	5	M	33	White Fir	2	P	100
Eucalyptus	3	S	33	Montane Riparian	5	P	55	White Fir	2	S	100
Eucalyptus	4	D	33	Montane Riparian	5	S	66	White Fir	2		100
Eucalyptus	4	M	33	Orchard - Vineyard			23	White Fir	3	D	55
Eucalyptus	4	P	33	Pasture			12	White Fir	3	M	66
Eucalyptus	4	S	33	Perennial Grassland		D	44	White Fir	3	P	100
Eucalyptus	5	D	33	Perennial Grassland		M	44	White Fir	3	S	100
Eucalyptus	5	M	33	Perennial Grassland		P	44	White Fir	3		66
Eucalyptus	5	P	33	Perennial Grassland		S	44	White Fir	4	D	33
Eucalyptus	5	S	33	Pinyon-Juniper	2	D	66	White Fir	4	M	55
Fresh Emergent Wetland		P	44	Pinyon-Juniper	2	M	100	White Fir	4	P	66
Fresh Emergent Wetland		S	44	Pinyon-Juniper	2	P	100	White Fir	4	S	89
Fresh Emergent Wetland		M	44	Pinyon-Juniper	2	S	100	White Fir	4		55
Hardwood			55	Pinyon-Juniper	3	D	55	White Fir	5	D	33
Irrigated Grain Crops			23	Pinyon-Juniper	3	M	66	White Fir	5	M	33
Irrigated Row and Field Crops			23	Pinyon-Juniper	3	P	100	White Fir	5	P	55
Irrigated Hayfield			23	Pinyon-Juniper	3	S	100	White Fir	5	S	66

Bobcat (*Lynx rufus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
				Pinyon-Juniper	3		66	White Fir	5		33
				Pinyon-Juniper	4	D	33	White Fir	6		55
				Pinyon-Juniper	4	M	55	Wet Meadow		D	44
				Pinyon-Juniper	4	P	66	Wet Meadow		M	44
				Pinyon-Juniper	4	S	89	Wet Meadow		P	44
				Pinyon-Juniper	4		55	Wet Meadow		S	44
				Pinyon-Juniper	5	D	33	Wet Meadow	1		44
				Pinyon-Juniper	5	M	33	Wet Meadow	2		44
				Pinyon-Juniper	5	P	55				
				Pinyon-Juniper	5	S	66				

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Alpine-Dwarf Shrub			33	Jeffrey Pine	1		100	Palm Oasis			33
Agriculture			77	Jeffrey Pine	2	D	33	Ponderosa Pine	1		100
Annual Grassland		P	100	Jeffrey Pine	2	M	33	Ponderosa Pine	2	D	33
Annual Grassland		S	100	Jeffrey Pine	2	P	66	Ponderosa Pine	2	M	33
Annual Grassland			100	Jeffrey Pine	2	S	66	Ponderosa Pine	2	P	66
Alkali Desert Scrub			33	Jeffrey Pine	3	D	33	Ponderosa Pine	2	S	66
Aspen	1		66	Jeffrey Pine	3	M	33	Ponderosa Pine	2		33
Aspen	2	M	55	Jeffrey Pine	3	P	66	Ponderosa Pine	3	D	33
Aspen	2	S	66	Jeffrey Pine	3	S	66	Ponderosa Pine	3	M	33
Aspen	3	S	55	Jeffrey Pine	3		33	Ponderosa Pine	3	P	66
Aspen	4	S	55	Jeffrey Pine	4	D	33	Ponderosa Pine	3	S	66
Barren			33	Jeffrey Pine	4	M	33	Ponderosa Pine	3		33
Bitterbrush			33	Jeffrey Pine	4	P	66	Ponderosa Pine	4	D	33
Blue Oak-Foothill Pine	1		100	Jeffrey Pine	4	S	66	Ponderosa Pine	4	M	33
Blue Oak-Foothill Pine	2	D	66	Jeffrey Pine	4		33	Ponderosa Pine	4	P	66
Blue Oak-Foothill Pine	2	M	66	Jeffrey Pine	5	D	33	Ponderosa Pine	4	S	66
Blue Oak-Foothill Pine	2	P	100	Jeffrey Pine	5	M	33	Ponderosa Pine	4		33
Blue Oak-Foothill Pine	2	S	100	Jeffrey Pine	5	P	66	Ponderosa Pine	5	M	33
Blue Oak-Foothill Pine	3	D	33	Jeffrey Pine	5	S	66	Ponderosa Pine	5	P	66
Blue Oak-Foothill Pine	3	M	33	Jeffrey Pine	5		33	Ponderosa Pine	5	S	66
Blue Oak-Foothill Pine	3	P	66	Joshua Tree	1		33	Ponderosa Pine	5		33
Blue Oak-Foothill Pine	3	S	66	Joshua Tree	2	D	33	Ponderosa Pine	6		33
Blue Oak-Foothill Pine	4	D	33	Joshua Tree	2	M	33	Redwood	1		66
Blue Oak-Foothill Pine	4	M	33	Joshua Tree	2	P	33	Redwood	2	M	33
Blue Oak-Foothill Pine	4	P	66	Joshua Tree	2	S	33	Redwood	2	P	33
Blue Oak-Foothill Pine	4	S	66	Joshua Tree	3	D	33	Redwood	2	S	33
Blue Oak-Foothill Pine	5	M	33	Joshua Tree	3	M	33	Redwood	3	M	33
Blue Oak-Foothill Pine	5	P	66	Joshua Tree	3	P	33	Redwood	3	P	33

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score
Blue Oak-Foothill Pine	5	S	66
Blue Oak Woodland	1		100
Blue Oak Woodland	2	D	66
Blue Oak Woodland	2	M	66
Blue Oak Woodland	2	P	100
Blue Oak Woodland	2	S	100
Blue Oak Woodland	3	D	33
Blue Oak Woodland	3	M	33
Blue Oak Woodland	3	P	66
Blue Oak Woodland	3	S	66
Blue Oak Woodland	4	D	33
Blue Oak Woodland	4	M	33
Blue Oak Woodland	4	P	66
Blue Oak Woodland	4	S	66
Blue Oak Woodland	5	D	33
Blue Oak Woodland	5	M	33
Blue Oak Woodland	5	P	66
Blue Oak Woodland	5	S	66
Coastal Oak Woodland	1		100
Coastal Oak Woodland	2	D	66
Coastal Oak Woodland	2	M	66
Coastal Oak Woodland	2	P	100
Coastal Oak Woodland	2	S	100
Coastal Oak Woodland	3	D	33
Coastal Oak Woodland	3	M	33
Coastal Oak Woodland	3	P	66
Coastal Oak Woodland	3	S	66
Coastal Oak Woodland	4	D	33
Coastal Oak Woodland	4	M	33

WHR NAME	Size	Density	Habitat Score
Joshua Tree	3	S	33
Joshua Tree	4	D	33
Joshua Tree	4	M	33
Juniper	1		66
Juniper	2	M	33
Juniper	2	P	33
Juniper	2	S	33
Juniper	2		33
Juniper	3	M	33
Juniper	3	P	33
Juniper	3	S	33
Juniper	3		33
Juniper	4	M	33
Juniper	4	P	33
Juniper	4	S	33
Juniper	4		33
Juniper	5	M	33
Juniper	5	P	33
Juniper	5	S	33
Juniper	5		33
Klamath Mixed Conifer	1		100
Klamath Mixed Conifer	2	D	33
Klamath Mixed Conifer	2	M	33
Klamath Mixed Conifer	2	P	66
Klamath Mixed Conifer	2	S	66
Klamath Mixed Conifer	2		33
Klamath Mixed Conifer	3	D	33
Klamath Mixed Conifer	3	M	33
Klamath Mixed Conifer	3	P	66

WHR NAME	Size	Density	Habitat Score
Redwood	3	S	33
Redwood	4	M	33
Redwood	4	P	33
Redwood	4	S	33
Redwood	5	M	33
Redwood	5	P	33
Redwood	5	S	33
Red Fir	1		66
Red Fir	2	M	33
Red Fir	2	P	33
Red Fir	2	S	33
Red Fir	2		33
Red Fir	3	M	33
Red Fir	3	P	33
Red Fir	3	S	33
Red Fir	3		33
Red Fir	4	M	33
Red Fir	4	P	33
Red Fir	4	S	33
Red Fir	4		33
Red Fir	5	M	33
Red Fir	5	P	33
Red Fir	5	S	33
Red Fir	5		33
Subalpine Conifer	1		66
Subalpine Conifer	2	M	33
Subalpine Conifer	2	P	33
Subalpine Conifer	2	S	66
Subalpine Conifer	2		33

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Coastal Oak Woodland	4	P	66	Klamath Mixed Conifer	3	S	66	Subalpine Conifer	3	M	33
Coastal Oak Woodland	4	S	66	Klamath Mixed Conifer	3		33	Subalpine Conifer	3	P	33
Coastal Oak Woodland	5	D	33	Klamath Mixed Conifer	4	D	33	Subalpine Conifer	3	S	33
Coastal Oak Woodland	5	M	33	Klamath Mixed Conifer	4	M	33	Subalpine Conifer	3		33
Coastal Oak Woodland	5	P	66	Klamath Mixed Conifer	4	P	66	Subalpine Conifer	4	M	33
Coastal Oak Woodland	5	S	66	Klamath Mixed Conifer	4	S	66	Subalpine Conifer	4	P	33
Closed-Cone Pine-Cypress	1		100	Klamath Mixed Conifer	4		33	Subalpine Conifer	4	S	33
Closed-Cone Pine-Cypress	2	D	33	Klamath Mixed Conifer	5	D	33	Subalpine Conifer	4		33
Closed-Cone Pine-Cypress	2	M	66	Klamath Mixed Conifer	5	M	33	Subalpine Conifer	5	M	33
Closed-Cone Pine-Cypress	2	P	66	Klamath Mixed Conifer	5	P	66	Subalpine Conifer	5	P	33
Closed-Cone Pine-Cypress	2	S	66	Klamath Mixed Conifer	5	S	66	Subalpine Conifer	5	S	33
Closed-Cone Pine-Cypress	3	D	33	Klamath Mixed Conifer	5		33	Subalpine Conifer	5		33
Closed-Cone Pine-Cypress	3	M	33	Lodgepole Pine	1		66	Sagebrush			33
Closed-Cone Pine-Cypress	3	P	66	Lodgepole Pine	2	M	33	Sierran Mixed Conifer	1		100
Closed-Cone Pine-Cypress	3	S	66	Lodgepole Pine	2	P	33	Sierran Mixed Conifer	2	D	33
Closed-Cone Pine-Cypress	4	D	33	Lodgepole Pine	2	S	33	Sierran Mixed Conifer	2	M	33
Closed-Cone Pine-Cypress	4	M	33	Lodgepole Pine	2		33	Sierran Mixed Conifer	2	P	66
Closed-Cone Pine-Cypress	4	P	66	Lodgepole Pine	3	M	33	Sierran Mixed Conifer	2	S	66
Closed-Cone Pine-Cypress	4	S	66	Lodgepole Pine	3	P	33	Sierran Mixed Conifer	2		33
Closed-Cone Pine-Cypress	5	D	33	Lodgepole Pine	3	S	33	Sierran Mixed Conifer	3	D	33
Closed-Cone Pine-Cypress	5	M	33	Lodgepole Pine	3		33	Sierran Mixed Conifer	3	M	33
Closed-Cone Pine-Cypress	5	P	66	Lodgepole Pine	4	M	33	Sierran Mixed Conifer	3	P	66
Closed-Cone Pine-Cypress	5	S	66	Lodgepole Pine	4	P	33	Sierran Mixed Conifer	3	S	66
Chamise-Redshank Chaparral		S	66	Lodgepole Pine	4	S	33	Sierran Mixed Conifer	3		33
Chamise-Redshank Chaparral		M	33	Lodgepole Pine	4		33	Sierran Mixed Conifer	4	D	33
Cropland			77	Lodgepole Pine	5	M	33	Sierran Mixed Conifer	4	M	33
Coastal Scrub			33	Lodgepole Pine	5	P	33	Sierran Mixed Conifer	4	P	66
Douglas Fir	1		66	Lodgepole Pine	5	S	33	Sierran Mixed Conifer	4	S	66
Douglas Fir	2	M	33	Low Sage			33	Sierran Mixed Conifer	4		33

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Douglas Fir	2	P	33	Mixed Chaparral		M	33	Sierran Mixed Conifer	5	D	33
Douglas Fir	2	S	33	Mixed Chaparral		P	66	Sierran Mixed Conifer	5	M	33
Douglas Fir	3	D	33	Mixed Chaparral		S	66	Sierran Mixed Conifer	5	P	66
Douglas Fir	3	M	33	Montane Chaparral		S	66	Sierran Mixed Conifer	5	S	66
Douglas Fir	3	P	33	Montane Chaparral		M	33	Sierran Mixed Conifer	5		33
Douglas Fir	3	S	33	Montane Hardwood-Conifer	1		100	Sierran Mixed Conifer	6		33
Douglas Fir	4	D	33	Montane Hardwood-Conifer	2	D	33	Urban			100
Douglas Fir	4	M	33	Montane Hardwood-Conifer	2	M	55	Vineyard			66
Douglas Fir	4	P	33	Montane Hardwood-Conifer	2	P	89	Valley Oak Woodland	2	D	66
Douglas Fir	4	S	33	Montane Hardwood-Conifer	2	S	100	Valley Oak Woodland	2	M	66
Douglas Fir	5	D	33	Montane Hardwood-Conifer	3	D	33	Valley Oak Woodland	2	P	100
Douglas Fir	5	M	33	Montane Hardwood-Conifer	3	M	33	Valley Oak Woodland	2	S	100
Douglas Fir	5	P	33	Montane Hardwood-Conifer	3	P	66	Valley Oak Woodland	3	D	33
Douglas Fir	5	S	33	Montane Hardwood-Conifer	3	S	66	Valley Oak Woodland	3	M	33
Douglas Fir	6		33	Montane Hardwood-Conifer	4	D	33	Valley Oak Woodland	3	P	66
Dryland Grain Crops			77	Montane Hardwood-Conifer	4	M	33	Valley Oak Woodland	3	S	66
Deciduous Orchard			66	Montane Hardwood-Conifer	4	P	66	Valley Oak Woodland	4	D	33
Desert Riparian	2	M	33	Montane Hardwood-Conifer	4	S	66	Valley Oak Woodland	4	M	33
Desert Riparian	2	P	33	Montane Hardwood-Conifer	5	D	33	Valley Oak Woodland	4	P	66
Desert Riparian	2	S	66	Montane Hardwood-Conifer	5	M	33	Valley Oak Woodland	4	S	66
Desert Riparian	3	M	33	Montane Hardwood-Conifer	5	P	66	Valley Oak Woodland	4		33
Desert Riparian	3	P	33	Montane Hardwood-Conifer	5	S	66	Valley Oak Woodland	5	D	33
Desert Riparian	3	S	66	Montane Hardwood-Conifer	6		33	Valley Oak Woodland	5	M	33
Desert Riparian	4	M	33	Montane Hardwood	1		100	Valley Oak Woodland	5	P	66
Desert Riparian	4	P	33	Montane Hardwood	2	D	33	Valley Oak Woodland	5	S	66
Desert Riparian	4	S	66	Montane Hardwood	2	M	55	Valley Oak Woodland	5		33
Desert Riparian	5	M	33	Montane Hardwood	2	P	100	Valley Oak Woodland	6		33
Desert Riparian	5	P	33	Montane Hardwood	2	S	100	Valley Foothill Riparian	1		66
Desert Riparian	5	S	66	Montane Hardwood	2		55	Valley Foothill Riparian	2	D	33

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Evergreen Orchard		S	66	Montane Hardwood	3	D	33	Valley Foothill Riparian	2	M	33
Eastside Pine	1		100	Montane Hardwood	3	M	33	Valley Foothill Riparian	2	P	66
Eastside Pine	2	D	33	Montane Hardwood	3	P	66	Valley Foothill Riparian	2	S	66
Eastside Pine	2	M	33	Montane Hardwood	3	S	66	Valley Foothill Riparian	2		33
Eastside Pine	2	P	66	Montane Hardwood	3		33	Valley Foothill Riparian	3	D	33
Eastside Pine	2	S	66	Montane Hardwood	4	D	33	Valley Foothill Riparian	3	M	33
Eastside Pine	3	D	33	Montane Hardwood	4	M	33	Valley Foothill Riparian	3	P	66
Eastside Pine	3	M	33	Montane Hardwood	4	P	66	Valley Foothill Riparian	3	S	66
Eastside Pine	3	P	66	Montane Hardwood	4	S	66	Valley Foothill Riparian	3		33
Eastside Pine	3	S	66	Montane Hardwood	4		33	Valley Foothill Riparian	4	D	33
Eastside Pine	4	D	33	Montane Hardwood	5	M	33	Valley Foothill Riparian	4	M	33
Eastside Pine	4	M	33	Montane Hardwood	5	P	66	Valley Foothill Riparian	4	P	66
Eastside Pine	4	P	66	Montane Hardwood	5	S	66	Valley Foothill Riparian	4	S	66
Eastside Pine	4	S	66	Montane Hardwood	5		33	Valley Foothill Riparian	4		33
Eastside Pine	5	D	33	Montane Hardwood	6		66	Valley Foothill Riparian	5	D	33
Eastside Pine	5	M	33	Montane Riparian	1		66	Valley Foothill Riparian	5	M	33
Eastside Pine	5	P	66	Montane Riparian	2	M	33	Valley Foothill Riparian	5	P	66
Eastside Pine	5	S	66	Montane Riparian	2	P	66	Valley Foothill Riparian	5	S	66
Eucalyptus	2	D	33	Montane Riparian	2	S	66	Valley Foothill Riparian	5		33
Eucalyptus	2	M	33	Montane Riparian	2		33	Valley Foothill Riparian	6		33
Eucalyptus	2	P	66	Montane Riparian	3	M	33	White Fir	1		100
Eucalyptus	2	S	66	Montane Riparian	3	P	66	White Fir	2	D	33
Eucalyptus	3	D	33	Montane Riparian	3	S	66	White Fir	2	M	33
Eucalyptus	3	M	33	Montane Riparian	3		33	White Fir	2	P	66
Eucalyptus	3	P	66	Montane Riparian	4	M	33	White Fir	2	S	66
Eucalyptus	3	S	66	Montane Riparian	4	P	66	White Fir	2		33
Eucalyptus	4	D	33	Montane Riparian	4	S	66	White Fir	3	D	33
Eucalyptus	4	M	33	Montane Riparian	4		33	White Fir	3	M	33
Eucalyptus	4	P	66	Montane Riparian	5	M	33	White Fir	3	P	66

California ground squirrel (*Spermophilus beecheyi*)

WHR NAME	Size	Density	Habitat Score
Eucalyptus	4	S	66
Eucalyptus	5	D	33
Eucalyptus	5	M	33
Eucalyptus	5	P	66
Eucalyptus	5	S	66
Hardwood			33
Irrigated Grain Crops			77
Irrigated Row and Field Crops			77
Irrigated Hayfield			77

WHR NAME	Size	Density	Habitat Score
Montane Riparian	5	P	66
Montane Riparian	5	S	66
Orchard - Vineyard			66
Pasture			100
Perennial Grassland		D	100
Perennial Grassland		M	100
Perennial Grassland		P	100
Perennial Grassland		S	100
Pinyon-Juniper	2	M	55
Pinyon-Juniper	2	P	100
Pinyon-Juniper	2	S	100
Pinyon-Juniper	3	M	33
Pinyon-Juniper	3	P	66
Pinyon-Juniper	3	S	66
Pinyon-Juniper	3		33
Pinyon-Juniper	4	M	33
Pinyon-Juniper	4	P	66
Pinyon-Juniper	4	S	66
Pinyon-Juniper	4		33
Pinyon-Juniper	5	M	33
Pinyon-Juniper	5	P	66
Pinyon-Juniper	5	S	66

WHR NAME	Size	Density	Habitat Score
White Fir	3	S	66
White Fir	3		33
White Fir	4	D	33
White Fir	4	M	33
White Fir	4	P	66
White Fir	4	S	66
White Fir	4		33
White Fir	5	D	33
White Fir	5	M	33
White Fir	5	P	66
White Fir	5	S	66
White Fir	5		33
White Fir	6		33
Wet Meadow		D	66
Wet Meadow		M	66
Wet Meadow		P	66
Wet Meadow		S	66
Wet Meadow	1		66
Wet Meadow	2		66

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Agriculture			33	Fresh Emergent Wetland		P	33	Perennial Grassland		D	100
Annual Grassland		P	100	Fresh Emergent Wetland		S	33	Perennial Grassland		M	100
Annual Grassland		S	100	Fresh Emergent Wetland		M	33	Perennial Grassland		P	100
Annual Grassland			100	Hardwood			33	Perennial Grassland		S	100
Alkali Desert Scrub			66	Irrigated Grain Crops			33	Pinyon-Juniper	2	D	33
Bitterbrush			100	Irrigated Row and Field Crops			33	Pinyon-Juniper	2	M	66
Blue Oak-Foothill Pine	1		66	Irrigated Hayfield			100	Pinyon-Juniper	2	P	66
Blue Oak-Foothill Pine	2	D	66	Jeffrey Pine	1		66	Pinyon-Juniper	2	S	66
Blue Oak-Foothill Pine	2	M	66	Jeffrey Pine	2	M	66	Pinyon-Juniper	3	D	33
Blue Oak-Foothill Pine	2	P	66	Jeffrey Pine	2	P	66	Pinyon-Juniper	3	M	100
Blue Oak-Foothill Pine	2	S	66	Jeffrey Pine	2	S	66	Pinyon-Juniper	3	P	100
Blue Oak-Foothill Pine	3	D	33	Jeffrey Pine	3	M	33	Pinyon-Juniper	3	S	100
Blue Oak-Foothill Pine	3	M	100	Jeffrey Pine	3	P	66	Pinyon-Juniper	3		100
Blue Oak-Foothill Pine	3	P	100	Jeffrey Pine	3	S	66	Pinyon-Juniper	4	D	33
Blue Oak-Foothill Pine	3	S	100	Jeffrey Pine	3		33	Pinyon-Juniper	4	M	100
Blue Oak-Foothill Pine	4	D	33	Jeffrey Pine	4	M	33	Pinyon-Juniper	4	P	100
Blue Oak-Foothill Pine	4	M	100	Jeffrey Pine	4	P	66	Pinyon-Juniper	4	S	100

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Blue Oak-Foothill Pine	4	P	100	Jeffrey Pine	4	S	66	Pinyon-Juniper	4		100
Blue Oak-Foothill Pine	4	S	100	Jeffrey Pine	4		33	Pinyon-Juniper	5	D	33
Blue Oak-Foothill Pine	5	D	33	Jeffrey Pine	5	M	33	Pinyon-Juniper	5	M	100
Blue Oak-Foothill Pine	5	M	100	Jeffrey Pine	5	P	66	Pinyon-Juniper	5	P	100
Blue Oak-Foothill Pine	5	P	100	Jeffrey Pine	5	S	66	Pinyon-Juniper	5	S	100
Blue Oak-Foothill Pine	5	S	100	Jeffrey Pine	5		33	Palm Oasis			66
Blue Oak Woodland	1		66	Joshua Tree	1		100	Ponderosa Pine	1		66
Blue Oak Woodland	2	D	66	Joshua Tree	2	D	100	Ponderosa Pine	2	D	33
Blue Oak Woodland	2	M	66	Joshua Tree	2	M	100	Ponderosa Pine	2	M	66
Blue Oak Woodland	2	P	66	Joshua Tree	2	P	100	Ponderosa Pine	2	P	66
Blue Oak Woodland	2	S	66	Joshua Tree	2	S	100	Ponderosa Pine	2	S	66
Blue Oak Woodland	3	D	33	Joshua Tree	3	D	100	Ponderosa Pine	2		66
Blue Oak Woodland	3	M	100	Joshua Tree	3	M	100	Ponderosa Pine	3	M	66
Blue Oak Woodland	3	P	100	Joshua Tree	3	P	100	Ponderosa Pine	3	P	66
Blue Oak Woodland	3	S	100	Joshua Tree	3	S	100	Ponderosa Pine	3	S	66
Blue Oak Woodland	4	D	33	Joshua Tree	4	D	100	Ponderosa Pine	3		66
Blue Oak Woodland	4	M	100	Joshua Tree	4	M	100	Ponderosa Pine	4	M	66
Blue Oak Woodland	4	P	100	Juniper	1		33	Ponderosa Pine	4	P	66
Blue Oak Woodland	4	S	100	Juniper	2	M	33	Ponderosa Pine	4	S	66
Blue Oak Woodland	5	D	33	Juniper	2	P	33	Ponderosa Pine	4		66
Blue Oak Woodland	5	M	100	Juniper	2	S	33	Ponderosa Pine	5	M	66
Blue Oak Woodland	5	P	100	Juniper	2		33	Ponderosa Pine	5	P	66
Blue Oak Woodland	5	S	100	Juniper	3	D	33	Ponderosa Pine	5	S	66
Coastal Oak	1		66	Juniper	3	M	33	Ponderosa Pine	5		66

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Woodland											
Coastal Oak Woodland	2	D	66	Juniper	3	P	33	Ponderosa Pine	6		66
Coastal Oak Woodland	2	M	66	Juniper	3	S	33	Redwood	1		33
Coastal Oak Woodland	2	P	66	Juniper	3		33	Redwood	2	M	33
Coastal Oak Woodland	2	S	66	Juniper	4	D	33	Redwood	2	P	33
Coastal Oak Woodland	3	D	33	Juniper	4	M	33	Redwood	2	S	33
Coastal Oak Woodland	3	M	100	Juniper	4	P	33	Redwood	3	P	33
Coastal Oak Woodland	3	P	100	Juniper	4	S	33	Redwood	3	S	33
Coastal Oak Woodland	3	S	100	Juniper	4		33	Redwood	4	P	33
Coastal Oak Woodland	4	D	33	Juniper	5	D	33	Redwood	4	S	33
Coastal Oak Woodland	4	M	100	Juniper	5	M	33	Redwood	5	P	33
Coastal Oak Woodland	4	P	100	Juniper	5	P	33	Redwood	5	S	33
Coastal Oak Woodland	4	S	100	Juniper	5	S	33	Sagebrush			100
Coastal Oak Woodland	5	D	33	Juniper	5		33	Sierran Mixed Conifer	1		66
Coastal Oak Woodland	5	M	100	Klamath Mixed Conifer	1		66	Sierran Mixed Conifer	2	M	66
Coastal Oak Woodland	5	P	100	Klamath Mixed Conifer	2	M	66	Sierran Mixed Conifer	2	P	66
Coastal Oak Woodland	5	S	100	Klamath Mixed Conifer	2	P	66	Sierran Mixed Conifer	2	S	66

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Closed-Cone Pine-Cypress	1		100	Klamath Mixed Conifer	2	S	66	Sierran Mixed Conifer	2		66
Closed-Cone Pine-Cypress	2	D	66	Klamath Mixed Conifer	2		66	Sierran Mixed Conifer	3	M	66
Closed-Cone Pine-Cypress	2	M	100	Klamath Mixed Conifer	3	M	66	Sierran Mixed Conifer	3	P	66
Closed-Cone Pine-Cypress	2	P	100	Klamath Mixed Conifer	3	P	66	Sierran Mixed Conifer	3	S	66
Closed-Cone Pine-Cypress	2	S	100	Klamath Mixed Conifer	3	S	66	Sierran Mixed Conifer	3		66
Closed-Cone Pine-Cypress	3	D	33	Klamath Mixed Conifer	3		66	Sierran Mixed Conifer	4	M	66
Closed-Cone Pine-Cypress	3	M	66	Klamath Mixed Conifer	4	M	66	Sierran Mixed Conifer	4	P	66
Closed-Cone Pine-Cypress	3	P	100	Klamath Mixed Conifer	4	P	66	Sierran Mixed Conifer	4	S	66
Closed-Cone Pine-Cypress	3	S	100	Klamath Mixed Conifer	4	S	66	Sierran Mixed Conifer	4		66
Closed-Cone Pine-Cypress	4	D	33	Klamath Mixed Conifer	4		66	Sierran Mixed Conifer	5	M	66
Closed-Cone Pine-Cypress	4	M	66	Klamath Mixed Conifer	5	M	66	Sierran Mixed Conifer	5	P	66
Closed-Cone Pine-Cypress	4	P	100	Klamath Mixed Conifer	5	P	66	Sierran Mixed Conifer	5	S	66
Closed-Cone Pine-Cypress	4	S	100	Klamath Mixed Conifer	5	S	66	Sierran Mixed Conifer	5		66
Closed-Cone Pine-Cypress	5	D	33	Klamath Mixed Conifer	5		66	Urban			33
Closed-Cone Pine-Cypress	5	M	66	Low Sage			33	Vineyard			66
Closed-Cone Pine-Cypress	5	P	100	Mixed Chaparral		D	33	Valley Oak Woodland	2	D	66
Closed-Cone Pine-Cypress	5	S	100	Mixed Chaparral		M	66	Valley Oak Woodland	2	M	66

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Chamise-Redshank Chaparral		S	100	Mixed Chaparral		P	100	Valley Oak Woodland	2	P	66
Chamise-Redshank Chaparral		M	66	Mixed Chaparral		S	100	Valley Oak Woodland	2	S	66
Cropland			33	Montane Chaparral		S	33	Valley Oak Woodland	3	D	33
Coastal Scrub			100	Montane Chaparral		M	33	Valley Oak Woodland	3	M	100
Douglas Fir	1		66	Montane Hardwood-Conifer	1		66	Valley Oak Woodland	3	P	100
Douglas Fir	2	D	33	Montane Hardwood-Conifer	2	D	33	Valley Oak Woodland	3	S	100
Douglas Fir	2	P	66	Montane Hardwood-Conifer	2	M	66	Valley Oak Woodland	4	D	33
Douglas Fir	2	S	66	Montane Hardwood-Conifer	2	P	66	Valley Oak Woodland	4	M	100
Douglas Fir	3	D	33	Montane Hardwood-Conifer	2	S	66	Valley Oak Woodland	4	P	100
Douglas Fir	3	P	66	Montane Hardwood-Conifer	3	M	33	Valley Oak Woodland	4	S	100
Douglas Fir	3	S	66	Montane Hardwood-Conifer	3	P	66	Valley Oak Woodland	4		100
Douglas Fir	4	D	33	Montane Hardwood-Conifer	3	S	66	Valley Oak Woodland	5	D	33
Douglas Fir	4	P	66	Montane Hardwood-Conifer	4	M	33	Valley Oak Woodland	5	M	100
Douglas Fir	4	S	66	Montane Hardwood-Conifer	4	P	66	Valley Oak Woodland	5	P	100
Douglas Fir	5	D	33	Montane Hardwood-Conifer	4	S	66	Valley Oak Woodland	5	S	100
Douglas Fir	5	P	66	Montane Hardwood-Conifer	5	M	33	Valley Oak Woodland	5		100
Douglas Fir	5	S	66	Montane Hardwood-Conifer	5	P	66	Valley Oak Woodland	6		33

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Dryland Grain Crops			66	Montane Hardwood-Conifer	5	S	66	Valley Foothill Riparian	1		100
Deciduous Orchard			66	Montane Hardwood	1		66	Valley Foothill Riparian	2	D	66
Desert Riparian	2	D	100	Montane Hardwood	2	M	33	Valley Foothill Riparian	2	M	100
Desert Riparian	2	M	100	Montane Hardwood	2	P	66	Valley Foothill Riparian	2	P	100
Desert Riparian	2	P	100	Montane Hardwood	2	S	66	Valley Foothill Riparian	2	S	100
Desert Riparian	2	S	100	Montane Hardwood	2		33	Valley Foothill Riparian	2		100
Desert Riparian	3	D	100	Montane Hardwood	3	M	33	Valley Foothill Riparian	3	D	33
Desert Riparian	3	M	100	Montane Hardwood	3	P	66	Valley Foothill Riparian	3	M	100
Desert Riparian	3	P	100	Montane Hardwood	3	S	66	Valley Foothill Riparian	3	P	100
Desert Riparian	3	S	100	Montane Hardwood	3		33	Valley Foothill Riparian	3	S	66
Desert Riparian	4	D	100	Montane Hardwood	4	M	33	Valley Foothill Riparian	3		100
Desert Riparian	4	M	100	Montane Hardwood	4	P	66	Valley Foothill Riparian	4	D	33
Desert Riparian	4	P	100	Montane Hardwood	4	S	66	Valley Foothill Riparian	4	M	100
Desert Riparian	4	S	100	Montane Hardwood	4		33	Valley Foothill Riparian	4	P	100
Desert Riparian	5	D	100	Montane Hardwood	5	M	33	Valley Foothill Riparian	4	S	100
Desert Riparian	5	M	100	Montane Hardwood	5	P	66	Valley Foothill Riparian	4		100
Desert Riparian	5	P	100	Montane Hardwood	5	S	66	Valley Foothill Riparian	5	D	33

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Desert Riparian	5	S	100	Montane Hardwood	5		33	Valley Foothill Riparian	5	M	100
Desert Scrub			100	Montane Hardwood	6		66	Valley Foothill Riparian	5	P	100
Desert Succulent Shrub			66	Montane Riparian	1		33	Valley Foothill Riparian	5	S	100
Desert Wash			66	Montane Riparian	2	M	100	Valley Foothill Riparian	5		100
Evergreen Orchard		S	66	Montane Riparian	2	P	100	Valley Foothill Riparian	6		33
Eastside Pine	1		66	Montane Riparian	2	S	100	White Fir	1		66
Eastside Pine	2	D	33	Montane Riparian	2		100	White Fir	2	M	66
Eastside Pine	2	M	66	Montane Riparian	3	P	33	White Fir	2	P	66
Eastside Pine	2	P	66	Montane Riparian	3	S	33	White Fir	2	S	66
Eastside Pine	2	S	66	Montane Riparian	4	M	100	White Fir	2		66
Eastside Pine	3	M	33	Montane Riparian	4	P	33	White Fir	3	M	66
Eastside Pine	3	P	66	Montane Riparian	4	S	33	White Fir	3	P	66
Eastside Pine	3	S	66	Montane Riparian	4		100	White Fir	3	S	66
Eastside Pine	4	M	33	Montane Riparian	5	D	33	White Fir	3		66
Eastside Pine	4	P	66	Montane Riparian	5	M	33	White Fir	4	M	66
Eastside Pine	4	S	66	Montane Riparian	5	P	100	White Fir	4	P	66
Eastside Pine	5	M	33	Montane Riparian	5	S	100	White Fir	4	S	66
Eastside Pine	5	P	66	Orchard - Vineyard			66	White Fir	4		66
Eastside Pine	5	S	66	Pasture			100	White Fir	5	M	66
Eucalyptus	2	D	66					White Fir	5	P	66
Eucalyptus	2	M	66					White Fir	5	S	66
Eucalyptus	2	P	66					White Fir	5		66
Eucalyptus	2	S	66					Wet Meadow		D	66
Eucalyptus	3	D	33					Wet Meadow		M	66

Gopher snake (*Pituophis catenifer*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Eucalyptus	3	M	33					Wet Meadow		P	66
Eucalyptus	3	P	66					Wet Meadow		S	66
Eucalyptus	3	S	66					Wet Meadow	1		66
Eucalyptus	4	D	33					Wet Meadow	2		66
Eucalyptus	4	M	33								
Eucalyptus	4	P	66								
Eucalyptus	5	D	33								
Eucalyptus	5	M	33								
Eucalyptus	5	P	66								
Eucalyptus	5	S	66								

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Agriculture			33	Fresh Emergent Wetland		P	34	Pinyon-Juniper	2	D	89
Annual Grassland		P	23	Fresh Emergent Wetland		M	34	Pinyon-Juniper	2	M	100
Annual Grassland		S	23	Hardwood			44	Pinyon-Juniper	2	P	100
Annual Grassland			23	Irrigated Grain Crops			33	Pinyon-Juniper	2	S	77
Alkali Desert Scrub			55	Irrigated Row and Field Crops			33	Pinyon-Juniper	3	M	55
Aspen	1		12	Irrigated Hayfield			45	Pinyon-Juniper	3	P	100
Aspen	2	D	22	Jeffrey Pine	1		34	Pinyon-Juniper	3	S	77
Aspen	2	M	22	Jeffrey Pine	2	D	89	Pinyon-Juniper	3		55
Aspen	2	P	33	Jeffrey Pine	2	M	89	Pinyon-Juniper	4	M	22
Aspen	2	S	33	Jeffrey Pine	2	P	100	Pinyon-Juniper	4	P	55
Aspen	3	P	33	Jeffrey Pine	2	S	77	Pinyon-Juniper	4	S	66
Aspen	3	S	33	Jeffrey Pine	3	D	55	Pinyon-Juniper	4		22
Aspen	4	P	22	Jeffrey Pine	3	M	89	Pinyon-Juniper	5	D	22
Aspen	4	S	33	Jeffrey Pine	3	P	100	Pinyon-Juniper	5	M	33
Bitterbrush			89	Jeffrey Pine	3	S	77	Pinyon-Juniper	5	P	33
Blue Oak-Foothill Pine	1		34	Jeffrey Pine	3		89	Pinyon-Juniper	5	S	33
Blue Oak-Foothill Pine	2	D	89	Jeffrey Pine	4	D	22	Palm Oasis			33
Blue Oak-Foothill Pine	2	M	100	Jeffrey Pine	4	M	44	Ponderosa Pine	1		23
Blue Oak-Foothill Pine	2	P	100	Jeffrey Pine	4	P	77	Ponderosa Pine	2	D	22
Blue Oak-Foothill Pine	2	S	77	Jeffrey Pine	4	S	77	Ponderosa Pine	2	M	66
Blue Oak-Foothill Pine	3	D	55	Jeffrey Pine	4		44	Ponderosa Pine	2	P	77
Blue Oak-Foothill Pine	3	M	89	Jeffrey Pine	5	P	22	Ponderosa Pine	2	S	55

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Blue Oak-Foothill Pine	3	P	100	Jeffrey Pine	5	S	44	Ponderosa Pine	2		66
Blue Oak-Foothill Pine	3	S	77	Joshua Tree	1		12	Ponderosa Pine	3	D	22
Blue Oak-Foothill Pine	4	D	33	Joshua Tree	2	D	33	Ponderosa Pine	3	M	55
Blue Oak-Foothill Pine	4	M	55	Joshua Tree	2	M	33	Ponderosa Pine	3	P	66
Blue Oak-Foothill Pine	4	P	100	Joshua Tree	2	P	33	Ponderosa Pine	3	S	55
Blue Oak-Foothill Pine	4	S	77	Joshua Tree	2	S	23	Ponderosa Pine	3		55
Blue Oak-Foothill Pine	5	M	33	Joshua Tree	3	D	33	Ponderosa Pine	4	D	22
Blue Oak-Foothill Pine	5	P	33	Joshua Tree	3	M	33	Ponderosa Pine	4	M	55
Blue Oak-Foothill Pine	5	S	44	Joshua Tree	3	P	33	Ponderosa Pine	4	P	66
Blue Oak Woodland	1		34	Joshua Tree	3	S	23	Ponderosa Pine	4	S	44
Blue Oak Woodland	2	D	89	Joshua Tree	4	D	33	Ponderosa Pine	4		55
Blue Oak Woodland	2	M	100	Joshua Tree	4	M	33	Ponderosa Pine	5	D	22
Blue Oak Woodland	2	P	100	Juniper	1		23	Ponderosa Pine	5	M	22
Blue Oak Woodland	2	S	77	Juniper	2	M	100	Ponderosa Pine	5	P	22
Blue Oak Woodland	3	D	55	Juniper	2	P	100	Ponderosa Pine	5	S	44
Blue Oak Woodland	3	M	89	Juniper	2	S	77	Ponderosa Pine	5		22
Blue Oak Woodland	3	P	100	Juniper	2		100	Ponderosa Pine	6		22
Blue Oak Woodland	3	S	77	Juniper	3	M	55	Redwood	1		34
Blue Oak Woodland	4	D	33	Juniper	3	P	100	Redwood	2	D	78
Blue Oak Woodland	4	M	55	Juniper	3	S	77	Redwood	2	M	100
Blue Oak Woodland	4	P	100	Juniper	3		55	Redwood	2	P	100
Blue Oak Woodland	4	S	77	Juniper	4	M	22	Redwood	2	S	77
Blue Oak Woodland	5	M	33	Juniper	4	P	55	Redwood	3	D	22

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Blue Oak Woodland	5	P	33	Juniper	4	S	66	Redwood	3	M	55
Blue Oak Woodland	5	S	44	Juniper	4		22	Redwood	3	P	100
Coastal Oak Woodland	1		34	Juniper	5	S	33	Redwood	3	S	77
Coastal Oak Woodland	2	D	89	Klamath Mixed Conifer	1		55	Redwood	4	D	22
Coastal Oak Woodland	2	M	100	Klamath Mixed Conifer	2	D	78	Redwood	4	M	33
Coastal Oak Woodland	2	P	100	Klamath Mixed Conifer	2	M	100	Redwood	4	P	44
Coastal Oak Woodland	2	S	77	Klamath Mixed Conifer	2	P	100	Redwood	4	S	44
Coastal Oak Woodland	3	D	55	Klamath Mixed Conifer	2	S	77	Redwood	5	D	33
Coastal Oak Woodland	3	M	89	Klamath Mixed Conifer	2		100	Redwood	5	M	33
Coastal Oak Woodland	3	P	100	Klamath Mixed Conifer	3	D	33	Redwood	5	P	33
Coastal Oak Woodland	3	S	77	Klamath Mixed Conifer	3	M	55	Redwood	5	S	33
Coastal Oak Woodland	4	D	33	Klamath Mixed Conifer	3	P	100	Saline Emergent Wetland			12
Coastal Oak Woodland	4	M	55	Klamath Mixed Conifer	3	S	77	Sagebrush			55
Coastal Oak Woodland	4	P	100	Klamath Mixed Conifer	3		55	Sierran Mixed Conifer	1		55
Coastal Oak Woodland	4	S	77	Klamath Mixed Conifer	4	D	33	Sierran Mixed Conifer	2	D	78
Coastal Oak Woodland	5	M	33	Klamath Mixed Conifer	4	M	33	Sierran Mixed Conifer	2	M	100
Coastal Oak Woodland	5	P	33	Klamath Mixed Conifer	4	P	44	Sierran Mixed Conifer	2	P	100
Coastal Oak Woodland	5	S	44	Klamath Mixed Conifer	4	S	44	Sierran Mixed Conifer	2	S	77

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Closed-Cone Pine-Cypress	1		23	Klamath Mixed Conifer	4		33	Sierran Mixed Conifer	2		100
Closed-Cone Pine-Cypress	2	D	22	Klamath Mixed Conifer	5	M	33	Sierran Mixed Conifer	3	D	33
Closed-Cone Pine-Cypress	2	M	33	Klamath Mixed Conifer	5	P	33	Sierran Mixed Conifer	3	M	55
Closed-Cone Pine-Cypress	2	P	44	Klamath Mixed Conifer	5	S	33	Sierran Mixed Conifer	3	P	100
Closed-Cone Pine-Cypress	2	S	23	Klamath Mixed Conifer	5		33	Sierran Mixed Conifer	3	S	77
Closed-Cone Pine-Cypress	3	D	22	Low Sage			55	Sierran Mixed Conifer	3		55
Closed-Cone Pine-Cypress	3	M	33	Mixed Chaparral		D	89	Sierran Mixed Conifer	4	D	33
Closed-Cone Pine-Cypress	3	P	44	Mixed Chaparral		M	89	Sierran Mixed Conifer	4	M	33
Closed-Cone Pine-Cypress	3	S	44	Mixed Chaparral		P	77	Sierran Mixed Conifer	4	P	44
Closed-Cone Pine-Cypress	4	M	33	Mixed Chaparral		S	55	Sierran Mixed Conifer	4	S	44
Closed-Cone Pine-Cypress	4	P	44	Montane Chaparral		S	55	Sierran Mixed Conifer	4		33
Closed-Cone Pine-Cypress	4	S	44	Montane Chaparral		M	89	Sierran Mixed Conifer	5	D	33
Closed-Cone Pine-Cypress	5	P	12	Montane Hardwood-Conifer	1		34	Sierran Mixed Conifer	5	M	33
Closed-Cone Pine-Cypress	5	S	33	Montane Hardwood-Conifer	2	D	78	Sierran Mixed Conifer	5	P	33
Chamise-Redshank Chaparral		S	55	Montane Hardwood-Conifer	2	M	100	Sierran Mixed Conifer	5	S	33
Chamise-Redshank Chaparral		M	89	Montane Hardwood-Conifer	2	P	100	Sierran Mixed Conifer	5		33
Cropland			33	Montane Hardwood-Conifer	2	S	77	Sierran Mixed Conifer	6		33

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Coastal Scrub			89	Montane Hardwood-Conifer	3	D	55	Urban			33
Douglas Fir	1		34	Montane Hardwood-Conifer	3	M	100	Vineyard			44
Douglas Fir	2	D	78	Montane Hardwood-Conifer	3	P	100	Valley Oak Woodland	2	D	89
Douglas Fir	2	M	100	Montane Hardwood-Conifer	3	S	77	Valley Oak Woodland	2	M	100
Douglas Fir	2	P	100	Montane Hardwood-Conifer	4	D	22	Valley Oak Woodland	2	P	100
Douglas Fir	2	S	77	Montane Hardwood-Conifer	4	M	44	Valley Oak Woodland	2	S	77
Douglas Fir	3	D	22	Montane Hardwood-Conifer	4	P	100	Valley Oak Woodland	3	D	55
Douglas Fir	3	M	55	Montane Hardwood-Conifer	4	S	77	Valley Oak Woodland	3	M	89
Douglas Fir	3	P	100	Montane Hardwood-Conifer	5	D	22	Valley Oak Woodland	3	P	100
Douglas Fir	3	S	77	Montane Hardwood-Conifer	5	M	22	Valley Oak Woodland	3	S	77
Douglas Fir	4	D	22	Montane Hardwood-Conifer	5	P	33	Valley Oak Woodland	4	D	33
Douglas Fir	4	M	33	Montane Hardwood-Conifer	5	S	44	Valley Oak Woodland	4	M	55
Douglas Fir	4	P	44	Montane Hardwood-Conifer	6		22	Valley Oak Woodland	4	P	100
Douglas Fir	4	S	44	Montane Hardwood	1		34	Valley Oak Woodland	4	S	77
Douglas Fir	5	D	22	Montane Hardwood	2	D	89	Valley Oak Woodland	4		55
Douglas Fir	5	M	33	Montane Hardwood	2	M	89	Valley Oak Woodland	5	M	33
Douglas Fir	5	P	33	Montane Hardwood	2	P	100	Valley Oak	5	P	33

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
								Woodland			
Douglas Fir	5	S	33	Montane Hardwood	2	S	77	Valley Oak Woodland	5	S	44
Dryland Grain Crops			33	Montane Hardwood	2		89	Valley Oak Woodland	5		33
Deciduous Orchard			22	Montane Hardwood	3	D	55	Valley Foothill Riparian	1		34
Desert Riparian	2	D	33	Montane Hardwood	3	M	89	Valley Foothill Riparian	2	D	55
Desert Riparian	2	M	33	Montane Hardwood	3	P	100	Valley Foothill Riparian	2	M	66
Desert Riparian	2	P	44	Montane Hardwood	3	S	77	Valley Foothill Riparian	2	P	55
Desert Riparian	2	S	23	Montane Hardwood	3		89	Valley Foothill Riparian	2	S	55
Desert Riparian	3	D	55	Montane Hardwood	4	D	22	Valley Foothill Riparian	2		66
Desert Riparian	3	M	55	Montane Hardwood	4	M	44	Valley Foothill Riparian	3	D	22
Desert Riparian	3	P	44	Montane Hardwood	4	P	77	Valley Foothill Riparian	3	M	66
Desert Riparian	3	S	23	Montane Hardwood	4	S	77	Valley Foothill Riparian	3	P	55
Desert Riparian	4	D	55	Montane Hardwood	4		44	Valley Foothill Riparian	3	S	55
Desert Riparian	4	M	55	Montane Hardwood	5	D	22	Valley Foothill Riparian	3		66
Desert Riparian	4	P	44	Montane Hardwood	5	P	22	Valley Foothill Riparian	4	D	22
Desert Riparian	4	S	23	Montane Hardwood	5	S	44	Valley Foothill Riparian	4	M	33
Desert Riparian	5	D	55	Montane Hardwood	6		22	Valley Foothill Riparian	4	P	44
Desert Riparian	5	M	55	Montane Riparian	1		23	Valley Foothill Riparian	4	S	44

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Desert Riparian	5	P	44	Montane Riparian	2	D	22	Valley Foothill Riparian	4		33
Desert Riparian	5	S	23	Montane Riparian	2	M	33	Valley Foothill Riparian	5	M	22
Desert Scrub			55	Montane Riparian	2	P	44	Valley Foothill Riparian	5	P	33
Desert Succulent Shrub			55	Montane Riparian	2	S	44	Valley Foothill Riparian	5	S	33
Desert Wash			33	Montane Riparian	2		33	Valley Foothill Riparian	5		22
Evergreen Orchard		S	22	Montane Riparian	3	M	33	White Fir	1		55
Eastside Pine	1		34	Montane Riparian	3	P	44	White Fir	2	D	78
Eastside Pine	2	D	89	Montane Riparian	3	S	44	White Fir	2	M	100
Eastside Pine	2	M	100	Montane Riparian	3		33	White Fir	2	P	100
Eastside Pine	2	P	100	Montane Riparian	4	M	22	White Fir	2	S	77
Eastside Pine	2	S	77	Montane Riparian	4	P	33	White Fir	2		100
Eastside Pine	3	D	55	Montane Riparian	4	S	33	White Fir	3	D	33
Eastside Pine	3	M	89	Montane Riparian	4		22	White Fir	3	M	55
Eastside Pine	3	P	100	Montane Riparian	5	P	22	White Fir	3	P	100
Eastside Pine	3	S	77	Montane Riparian	5	S	33	White Fir	3	S	77
Eastside Pine	4	D	22	Orchard - Vineyard			44	White Fir	3		55
Eastside Pine	4	M	44	Pasture			55	White Fir	4	D	33
Eastside Pine	4	P	100	Perennial Grassland		M	34	White Fir	4	M	33
Eastside Pine	4	S	77	Perennial Grassland		P	34	White Fir	4	P	44
Eastside Pine	5	P	33	Perennial Grassland		S	34	White Fir	4	S	44
Eastside Pine	5	S	44					White Fir	4		33
Eucalyptus	2	D	33					White Fir	5	M	33
Eucalyptus	2	M	33					White Fir	5	P	33
Eucalyptus	2	P	66					White Fir	5	S	33
Eucalyptus	2	S	66					White Fir	5		33

Gray fox (*Urocyon cinereoargenteus*)

WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score	WHR Name	Size	Density	Habitat Score
Eucalyptus	3	D	33					Wet Meadow		D	34
Eucalyptus	3	M	33					Wet Meadow		M	34
Eucalyptus	3	P	66					Wet Meadow		P	34
Eucalyptus	3	S	66					Wet Meadow	1		34
Eucalyptus	4	D	33					Wet Meadow	2		55
Eucalyptus	4	M	33								
Eucalyptus	4	P	66								
Eucalyptus	4	S	66								
Eucalyptus	5	D	33								
Eucalyptus	5	M	33								
Eucalyptus	5	P	66								
Eucalyptus	5	S	66								

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Agriculture			12	Joshua Tree	1		23	Palm Oasis			23
Annual Grassland		P	34	Joshua Tree	2	D	23	Ponderosa Pine	1		12
Annual Grassland		S	34	Joshua Tree	2	M	23	Ponderosa Pine	2	D	12
Annual Grassland			34	Joshua Tree	2	P	23	Ponderosa Pine	2	M	12
Alkali Desert Scrub			12	Joshua Tree	2	S	23	Ponderosa Pine	2	P	12
Barren			67	Joshua Tree	3	D	23	Ponderosa Pine	2	S	12
Bitterbrush			23	Joshua Tree	3	M	23	Ponderosa Pine	2		12
Blue Oak-Foothill Pine	1		66	Joshua Tree	3	P	23	Ponderosa Pine	3	D	12
Blue Oak-Foothill Pine	2	D	66	Joshua Tree	3	S	23	Ponderosa Pine	3	M	12
Blue Oak-Foothill Pine	2	M	66	Joshua Tree	4	D	23	Ponderosa Pine	3	P	12
Blue Oak-Foothill Pine	2	P	66	Joshua Tree	4	M	23	Ponderosa Pine	3	S	12
Blue Oak-Foothill Pine	2	S	66	Juniper	1		12	Ponderosa Pine	3		12
Blue Oak-Foothill Pine	3	D	66	Juniper	2	M	12	Ponderosa Pine	4	D	12
Blue Oak-Foothill Pine	3	M	66	Juniper	2	P	12	Ponderosa Pine	4	M	12
Blue Oak-Foothill Pine	3	P	66	Juniper	2	S	12	Ponderosa Pine	4	P	12
Blue Oak-Foothill Pine	3	S	66	Juniper	2		12	Ponderosa Pine	4	S	12
Blue Oak-Foothill Pine	4	D	66	Juniper	3	D	12	Ponderosa Pine	4		12
Blue Oak-Foothill Pine	4	M	66	Juniper	3	M	12	Ponderosa Pine	5	D	12
Blue Oak-Foothill Pine	4	P	66	Juniper	3	P	12	Ponderosa Pine	5	M	12
Blue Oak-Foothill Pine	4	S	66	Juniper	3	S	12	Ponderosa Pine	5	P	12

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Blue Oak-Foothill Pine	5	D	66	Juniper	3		12	Ponderosa Pine	5	S	12
Blue Oak-Foothill Pine	5	M	66	Juniper	4	D	12	Ponderosa Pine	5		12
Blue Oak-Foothill Pine	5	P	66	Juniper	4	M	12	Ponderosa Pine	6		12
Blue Oak-Foothill Pine	5	S	66	Juniper	4	P	12	Redwood	1		12
Blue Oak Woodland	1		77	Juniper	4	S	12	Redwood	2	D	12
Blue Oak Woodland	2	D	77	Juniper	4		12	Redwood	2	M	12
Blue Oak Woodland	2	M	77	Juniper	5	D	12	Redwood	2	P	12
Blue Oak Woodland	2	P	77	Juniper	5	M	12	Redwood	2	S	12
Blue Oak Woodland	2	S	77	Juniper	5	P	12	Redwood	3	D	12
Blue Oak Woodland	3	D	77	Juniper	5	S	12	Redwood	3	M	12
Blue Oak Woodland	3	M	77	Juniper	5		12	Redwood	3	P	12
Blue Oak Woodland	3	P	77	Klamath Mixed Conifer	1		33	Redwood	3	S	12
Blue Oak Woodland	3	S	77	Klamath Mixed Conifer	2	D	33	Redwood	4	D	12
Blue Oak Woodland	4	D	66	Klamath Mixed Conifer	2	M	33	Redwood	4	M	12
Blue Oak Woodland	4	M	77	Klamath Mixed Conifer	2	P	33	Redwood	4	P	12
Blue Oak Woodland	4	P	77	Klamath Mixed Conifer	2	S	33	Redwood	4	S	12
Blue Oak Woodland	4	S	77	Klamath Mixed Conifer	2		33	Redwood	5	D	12
Blue Oak Woodland	5	D	66	Klamath Mixed Conifer	3	D	33	Redwood	5	M	12
Blue Oak Woodland	5	M	77	Klamath Mixed Conifer	3	M	33	Redwood	5	P	12
Blue Oak Woodland	5	P	77	Klamath Mixed Conifer	3	P	33	Redwood	5	S	12

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Blue Oak Woodland	5	S	77	Klamath Mixed Conifer	3	S	33	Red Fir	1		12
Coastal Oak Woodland	1		77	Klamath Mixed Conifer	3		33	Red Fir	2	D	12
Coastal Oak Woodland	2	D	77	Klamath Mixed Conifer	4	D	33	Red Fir	2	M	12
Coastal Oak Woodland	2	M	77	Klamath Mixed Conifer	4	M	33	Red Fir	2	P	12
Coastal Oak Woodland	2	P	77	Klamath Mixed Conifer	4	P	33	Red Fir	2	S	12
Coastal Oak Woodland	2	S	77	Klamath Mixed Conifer	4	S	33	Red Fir	2		12
Coastal Oak Woodland	3	D	77	Klamath Mixed Conifer	4		33	Red Fir	3	D	12
Coastal Oak Woodland	3	M	77	Klamath Mixed Conifer	5	D	33	Red Fir	3	M	12
Coastal Oak Woodland	3	P	77	Klamath Mixed Conifer	5	M	33	Red Fir	3	P	12
Coastal Oak Woodland	3	S	77	Klamath Mixed Conifer	5	P	33	Red Fir	3	S	12
Coastal Oak Woodland	4	D	66	Klamath Mixed Conifer	5	S	33	Red Fir	3		12
Coastal Oak Woodland	4	M	77	Klamath Mixed Conifer	5		33	Red Fir	4	D	12
Coastal Oak Woodland	4	P	77	Lodgepole Pine	1		12	Red Fir	4	M	12
Coastal Oak Woodland	4	S	77	Lodgepole Pine	2	D	12	Red Fir	4	P	12
Coastal Oak Woodland	5	D	66	Lodgepole Pine	2	M	12	Red Fir	4	S	12
Coastal Oak Woodland	5	M	77	Lodgepole Pine	2	P	12	Red Fir	4		12
Coastal Oak Woodland	5	P	77	Lodgepole Pine	2	S	12	Red Fir	5	D	12
Coastal Oak	5	S	77	Lodgepole Pine	2		12	Red Fir	5	M	12

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Woodland											
Chamise-Redshank Chaparral		S	66	Lodgepole Pine	3	D	12	Red Fir	5	P	12
Chamise-Redshank Chaparral		M	66	Lodgepole Pine	3	M	12	Red Fir	5	S	12
Cropland			12	Lodgepole Pine	3	P	12	Red Fir	5		12
Coastal Scrub			66	Lodgepole Pine	3	S	12	Red Fir	6		12
Douglas Fir	1		12	Lodgepole Pine	3		12	Riverine			12
Douglas Fir	2	D	12	Lodgepole Pine	4	D	12	Sagebrush			23
Douglas Fir	2	M	12	Lodgepole Pine	4	M	12	Sierran Mixed Conifer	1		33
Douglas Fir	2	P	12	Lodgepole Pine	4	P	12	Sierran Mixed Conifer	2	D	33
Douglas Fir	2	S	12	Lodgepole Pine	4	S	12	Sierran Mixed Conifer	2	M	33
Douglas Fir	3	D	12	Lodgepole Pine	4		12	Sierran Mixed Conifer	2	P	33
Douglas Fir	3	M	12	Lodgepole Pine	5	D	12	Sierran Mixed Conifer	2	S	33
Douglas Fir	3	P	12	Lodgepole Pine	5	M	12	Sierran Mixed Conifer	2		33
Douglas Fir	3	S	12	Lodgepole Pine	5	P	12	Sierran Mixed Conifer	3	D	33
Douglas Fir	4	D	12	Lodgepole Pine	5	S	12	Sierran Mixed Conifer	3	M	33
Douglas Fir	4	M	12	Lodgepole Pine	6		12	Sierran Mixed Conifer	3	P	33
Douglas Fir	4	P	12	Low Sage			12	Sierran Mixed Conifer	3	S	33
Douglas Fir	4	S	12	Mixed Chaparral		D	66	Sierran Mixed Conifer	3		33
Douglas Fir	5	D	12	Mixed Chaparral		M	66	Sierran Mixed Conifer	4	D	33

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Douglas Fir	5	M	12	Mixed Chaparral		P	66	Sierran Mixed Conifer	4	M	33
Douglas Fir	5	P	12	Mixed Chaparral		S	66	Sierran Mixed Conifer	4	P	33
Douglas Fir	5	S	12	Montane Chaparral		S	12	Sierran Mixed Conifer	4	S	33
Douglas Fir	6		12	Montane Chaparral		M	12	Sierran Mixed Conifer	4		33
Dryland Grain Crops			12	Montane Hardwood-Conifer	1		12	Sierran Mixed Conifer	5	D	33
Deciduous Orchard			12	Montane Hardwood-Conifer	2	D	12	Sierran Mixed Conifer	5	M	33
Desert Riparian	2	D	23	Montane Hardwood-Conifer	2	M	12	Sierran Mixed Conifer	5	P	33
Desert Riparian	2	M	23	Montane Hardwood-Conifer	2	P	12	Sierran Mixed Conifer	5	S	33
Desert Riparian	2	P	23	Montane Hardwood-Conifer	2	S	12	Sierran Mixed Conifer	5		33
Desert Riparian	2	S	23	Montane Hardwood-Conifer	3	D	12	Sierran Mixed Conifer	6		33
Desert Riparian	3	D	23	Montane Hardwood-Conifer	3	M	12	Urban			55
Desert Riparian	3	M	23	Montane Hardwood-Conifer	3	P	12	Vineyard			23
Desert Riparian	3	P	23	Montane Hardwood-Conifer	3	S	12	Valley Oak Woodland	2	D	77
Desert Riparian	3	S	23	Montane Hardwood-Conifer	4	D	12	Valley Oak Woodland	2	M	77
Desert Riparian	4	D	23	Montane Hardwood-Conifer	4	M	12	Valley Oak Woodland	2	P	77
Desert Riparian	4	M	23	Montane Hardwood-Conifer	4	P	12	Valley Oak Woodland	2	S	77
Desert Riparian	4	P	23	Montane Hardwood-Conifer	4	S	12	Valley Oak Woodland	3	D	77
Desert Riparian	4	S	23	Montane	5	D	12	Valley Oak	3	M	77

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
				Hardwood-Conifer				Woodland			
Desert Riparian	5	D	23	Montane Hardwood-Conifer	5	M	12	Valley Oak Woodland	3	P	77
Desert Riparian	5	M	23	Montane Hardwood-Conifer	5	P	12	Valley Oak Woodland	3	S	77
Desert Riparian	5	P	23	Montane Hardwood-Conifer	5	S	12	Valley Oak Woodland	4	D	66
Desert Riparian	5	S	23	Montane Hardwood-Conifer	6		12	Valley Oak Woodland	4	M	77
Desert Scrub			23	Montane Hardwood	1		12	Valley Oak Woodland	4	P	77
Desert Succulent Shrub			23	Montane Hardwood	2	D	12	Valley Oak Woodland	4	S	77
Desert Wash			23	Montane Hardwood	2	M	12	Valley Oak Woodland	4		77
Evergreen Orchard		S	12	Montane Hardwood	2	P	12	Valley Oak Woodland	5	D	66
Eastside Pine	1		12	Montane Hardwood	2	S	12	Valley Oak Woodland	5	M	77
Eastside Pine	2	D	12	Montane Hardwood	2		12	Valley Oak Woodland	5	P	77
Eastside Pine	2	M	12	Montane Hardwood	3	D	12	Valley Oak Woodland	5	S	77
Eastside Pine	2	P	12	Montane Hardwood	3	M	12	Valley Oak Woodland	5		77
Eastside Pine	2	S	12	Montane Hardwood	3	P	12	Valley Oak Woodland	6		66
Eastside Pine	3	D	12	Montane Hardwood	3	S	12	Valley Foothill Riparian	1		23
Eastside Pine	3	M	12	Montane Hardwood	3		12	Valley Foothill Riparian	2	D	23
Eastside Pine	3	P	12	Montane Hardwood	4	D	12	Valley Foothill Riparian	2	M	23
Eastside Pine	3	S	12	Montane Hardwood	4	M	12	Valley Foothill Riparian	2	P	23

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Eastside Pine	4	D	12	Montane Hardwood	4	P	12	Valley Foothill Riparian	2	S	23
Eastside Pine	4	M	12	Montane Hardwood	4	S	12	Valley Foothill Riparian	2		23
Eastside Pine	4	P	12	Montane Hardwood	4		12	Valley Foothill Riparian	3	D	23
Eastside Pine	4	S	12	Montane Hardwood	5	D	12	Valley Foothill Riparian	3	M	23
Eastside Pine	5	D	12	Montane Hardwood	5	M	12	Valley Foothill Riparian	3	P	23
Eastside Pine	5	M	12	Montane Hardwood	5	P	12	Valley Foothill Riparian	3	S	23
Eastside Pine	5	P	12	Montane Hardwood	5	S	12	Valley Foothill Riparian	3		23
Eastside Pine	5	S	12	Montane Hardwood	5		12	Valley Foothill Riparian	4	D	23
Eucalyptus	2	D	33	Montane Hardwood	6		12	Valley Foothill Riparian	4	M	23
Eucalyptus	2	M	33	Montane Riparian	1		12	Valley Foothill Riparian	4	P	23
Eucalyptus	2	P	44	Montane Riparian	2	D	12	Valley Foothill Riparian	4	S	23
Eucalyptus	2	S	44	Montane Riparian	2	M	12	Valley Foothill Riparian	4		23
Eucalyptus	3	D	33	Montane Riparian	2	P	12	Valley Foothill Riparian	5	D	23
Eucalyptus	3	M	33	Montane Riparian	2	S	12	Valley Foothill Riparian	5	M	23
Eucalyptus	3	P	44	Montane Riparian	2		12	Valley Foothill Riparian	5	P	23
Eucalyptus	3	S	44	Montane Riparian	3	D	12	Valley Foothill Riparian	5	S	23
Eucalyptus	4	D	33	Montane Riparian	3	M	12	Valley Foothill Riparian	5		23
Eucalyptus	4	M	33	Montane Riparian	3	P	12	Valley Foothill	6		23

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
								Riparian			
Eucalyptus	4	P	44	Montane Riparian	3	S	12	White Fir	1		33
Eucalyptus	4	S	44	Montane Riparian	3		12	White Fir	2	D	33
Eucalyptus	5	D	33	Montane Riparian	4	D	12	White Fir	2	M	33
Eucalyptus	5	M	33	Montane Riparian	4	M	12	White Fir	2	P	33
Eucalyptus	5	P	44	Montane Riparian	4	P	12	White Fir	2	S	33
Eucalyptus	5	S	44	Montane Riparian	4	S	12	White Fir	2		33
Hardwood			12	Montane Riparian	4		12	White Fir	3	D	33
Irrigated Grain Crops			12	Montane Riparian	5	D	12	White Fir	3	M	33
Irrigated Row and Field Crops			12	Montane Riparian	5	M	12	White Fir	3	P	33
Irrigated Hayfield			34	Montane Riparian	5	P	12	White Fir	3	S	33
Jeffrey Pine	1		12	Montane Riparian	5	S	12	White Fir	3		33
Jeffrey Pine	2	D	12	Orchard - Vineyard			23	White Fir	4	D	33
Jeffrey Pine	2	M	12	Pasture			34	White Fir	4	M	33
Jeffrey Pine	2	P	12	Perennial Grassland		D	23	White Fir	4	P	33
Jeffrey Pine	2	S	12	Perennial Grassland		M	23	White Fir	4	S	33
Jeffrey Pine	3	D	12	Perennial Grassland		P	23	White Fir	4		33
Jeffrey Pine	3	M	12	Perennial Grassland		S	23	White Fir	5	D	33
Jeffrey Pine	3	P	12	Pinyon-Juniper	2	D	12	White Fir	5	M	33
Jeffrey Pine	3	S	12	Pinyon-Juniper	2	M	12	White Fir	5	P	33
Jeffrey Pine	3		12	Pinyon-Juniper	2	P	12	White Fir	5	S	33
Jeffrey Pine	4	D	12	Pinyon-Juniper	2	S	12	White Fir	5		33
Jeffrey Pine	4	M	12	Pinyon-Juniper	3	D	12	White Fir	6		33
Jeffrey Pine	4	P	12	Pinyon-Juniper	3	M	12	Wet Meadow		D	12
Jeffrey Pine	4	S	12	Pinyon-Juniper	3	P	12	Wet Meadow		M	12
Jeffrey Pine	4		12	Pinyon-Juniper	3	S	12	Wet Meadow		P	12
Jeffrey Pine	5	D	12	Pinyon-Juniper	3		12	Wet Meadow		S	12

Pallid bat (*Antrozous pallidus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Jeffrey Pine	5	M	12	Pinyon-Juniper	4	D	12	Wet Meadow	1		12
Jeffrey Pine	5	P	12	Pinyon-Juniper	4	M	12	Wet Meadow	2		12
Jeffrey Pine	5	S	12	Pinyon-Juniper	4	P	12				
Jeffrey Pine	5		12	Pinyon-Juniper	4	S	12				
				Pinyon-Juniper	4		12				
				Pinyon-Juniper	5	D	12				
				Pinyon-Juniper	5	M	12				
				Pinyon-Juniper	5	P	12				
				Pinyon-Juniper	5	S	12				

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Agriculture			33	Jeffrey Pine	1		33	Pinyon-Juniper	2	M	66
Annual Grassland		P	100	Jeffrey Pine	2	M	33	Pinyon-Juniper	2	P	66
Annual Grassland		S	100	Jeffrey Pine	2	P	33	Pinyon-Juniper	2	S	66
Annual Grassland			100	Jeffrey Pine	2	S	33	Pinyon-Juniper	3	M	66
Bitterbrush			66	Jeffrey Pine	3	M	33	Pinyon-Juniper	3	P	66
Blue Oak-Foothill Pine	1		66	Jeffrey Pine	3	P	33	Pinyon-Juniper	3	S	66
Blue Oak-Foothill Pine	2	D	33	Jeffrey Pine	3	S	33	Pinyon-Juniper	3		66
Blue Oak-Foothill Pine	2	M	66	Jeffrey Pine	3		33	Pinyon-Juniper	4	M	66
Blue Oak-Foothill Pine	2	P	66	Jeffrey Pine	4	M	33	Pinyon-Juniper	4	P	66
Blue Oak-Foothill Pine	2	S	66	Jeffrey Pine	4	P	33	Pinyon-Juniper	4	S	66
Blue Oak-Foothill Pine	3	M	66	Jeffrey Pine	4	S	33	Pinyon-Juniper	4		66
Blue Oak-Foothill Pine	3	P	66	Jeffrey Pine	4		33	Pinyon-Juniper	5	M	66
Blue Oak-Foothill Pine	3	S	66	Jeffrey Pine	5	M	33	Pinyon-Juniper	5	P	66
Blue Oak-Foothill Pine	4	M	66	Jeffrey Pine	5	P	33	Pinyon-Juniper	5	S	66
Blue Oak-Foothill Pine	4	P	66	Jeffrey Pine	5	S	33	Ponderosa Pine	1		66
Blue Oak-Foothill Pine	4	S	66	Jeffrey Pine	5		33	Ponderosa Pine	2	M	33
Blue Oak-Foothill Pine	5	M	66	Juniper	1		66	Ponderosa Pine	2	P	66
Blue Oak-Foothill Pine	5	P	66	Juniper	2	M	66	Ponderosa Pine	2	S	66
Blue Oak-Foothill Pine	5	S	66	Juniper	2	P	66	Ponderosa Pine	2		33

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Blue Oak Woodland	1		66	Juniper	2	S	66	Ponderosa Pine	3	M	33
Blue Oak Woodland	2	D	33	Juniper	2		66	Ponderosa Pine	3	P	66
Blue Oak Woodland	2	M	66	Juniper	3	M	66	Ponderosa Pine	3	S	66
Blue Oak Woodland	2	P	66	Juniper	3	P	66	Ponderosa Pine	3		33
Blue Oak Woodland	2	S	66	Juniper	3	S	66	Ponderosa Pine	4	M	33
Blue Oak Woodland	3	M	100	Juniper	3		66	Ponderosa Pine	4	P	66
Blue Oak Woodland	3	P	100	Juniper	4	M	66	Ponderosa Pine	4	S	66
Blue Oak Woodland	3	S	100	Juniper	4	P	66	Ponderosa Pine	4		33
Blue Oak Woodland	4	M	100	Juniper	4	S	66	Ponderosa Pine	5	M	33
Blue Oak Woodland	4	P	100	Juniper	4		66	Ponderosa Pine	5	P	66
Blue Oak Woodland	4	S	100	Juniper	5	M	66	Ponderosa Pine	5	S	66
Blue Oak Woodland	5	M	100	Juniper	5	P	66	Ponderosa Pine	5		33
Blue Oak Woodland	5	P	100	Juniper	5	S	66	Ponderosa Pine	6		33
Blue Oak Woodland	5	S	100	Juniper	5		66	Redwood	1		33
Coastal Oak Woodland	1		66	Klamath Mixed Conifer	1		66	Redwood	2	M	33
Coastal Oak Woodland	2	D	33	Klamath Mixed Conifer	2	M	66	Redwood	2	P	33
Coastal Oak Woodland	2	M	66	Klamath Mixed Conifer	2	P	66	Redwood	2	S	33
Coastal Oak Woodland	2	P	66	Klamath Mixed Conifer	2	S	66	Redwood	3	M	33
Coastal Oak Woodland	2	S	66	Klamath Mixed Conifer	2		66	Redwood	3	P	66
Coastal Oak Woodland	3	M	100	Klamath Mixed Conifer	3	M	33	Redwood	3	S	66
Coastal Oak Woodland	3	P	100	Klamath Mixed Conifer	3	P	66	Redwood	4	M	33
Coastal Oak Woodland	3	S	100	Klamath Mixed Conifer	3	S	66	Redwood	4	P	66
Coastal Oak Woodland	4	M	100	Klamath Mixed Conifer	3		33	Redwood	4	S	66

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Coastal Oak Woodland	4	P	100	Klamath Mixed Conifer	4	M	33	Redwood	5	M	33
Coastal Oak Woodland	4	S	100	Klamath Mixed Conifer	4	P	66	Redwood	5	P	66
Coastal Oak Woodland	5	M	100	Klamath Mixed Conifer	4	S	66	Redwood	5	S	66
Coastal Oak Woodland	5	P	100	Klamath Mixed Conifer	4		33	Sagebrush			66
Coastal Oak Woodland	5	S	100	Klamath Mixed Conifer	5	M	33	Sierran Mixed Conifer	1		66
Closed-Cone Pine-Cypress	1		66	Klamath Mixed Conifer	5	P	66	Sierran Mixed Conifer	2	M	66
Closed-Cone Pine-Cypress	2	M	33	Klamath Mixed Conifer	5	S	66	Sierran Mixed Conifer	2	P	66
Closed-Cone Pine-Cypress	2	P	66	Klamath Mixed Conifer	5		33	Sierran Mixed Conifer	2	S	66
Closed-Cone Pine-Cypress	2	S	66	Low Sage			33	Sierran Mixed Conifer	2		66
Closed-Cone Pine-Cypress	3	M	33	Mixed Chaparral		M	33	Sierran Mixed Conifer	3	M	33
Closed-Cone Pine-Cypress	3	P	66	Mixed Chaparral		P	66	Sierran Mixed Conifer	3	P	66
Closed-Cone Pine-Cypress	3	S	66	Mixed Chaparral		S	66	Sierran Mixed Conifer	3	S	66
Closed-Cone Pine-Cypress	4	M	33	Montane Chaparral		S	66	Sierran Mixed Conifer	3		33
Closed-Cone Pine-Cypress	4	P	66	Montane Chaparral		M	33	Sierran Mixed Conifer	4	M	33
Closed-Cone Pine-Cypress	4	S	66	Montane Hardwood-Conifer	1		66	Sierran Mixed Conifer	4	P	66
Closed-Cone Pine-Cypress	5	M	33	Montane Hardwood-Conifer	2	M	66	Sierran Mixed Conifer	4	S	66
Closed-Cone Pine-Cypress	5	P	66	Montane Hardwood-Conifer	2	P	66	Sierran Mixed Conifer	4		33
Closed-Cone Pine-	5	S	66	Montane Hardwood-	2	S	66	Sierran Mixed	5	M	33

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Cypress				Conifer				Conifer			
Chamise-Redshank Chaparral		S	66	Montane Hardwood-Conifer	3	M	33	Sierran Mixed Conifer	5	P	66
Chamise-Redshank Chaparral		M	33	Montane Hardwood-Conifer	3	P	66	Sierran Mixed Conifer	5	S	66
Cropland			33	Montane Hardwood-Conifer	3	S	66	Sierran Mixed Conifer	5		33
Coastal Scrub			66	Montane Hardwood-Conifer	4	M	33	Vineyard			33
Douglas Fir	1		33	Montane Hardwood-Conifer	4	P	66	Valley Oak Woodland	2	D	33
Douglas Fir	2	D	33	Montane Hardwood-Conifer	4	S	66	Valley Oak Woodland	2	M	66
Douglas Fir	2	M	33	Montane Hardwood-Conifer	5	M	33	Valley Oak Woodland	2	P	66
Douglas Fir	2	P	33	Montane Hardwood-Conifer	5	P	66	Valley Oak Woodland	2	S	66
Douglas Fir	2	S	33	Montane Hardwood-Conifer	5	S	66	Valley Oak Woodland	3	M	100
Douglas Fir	3	D	33	Montane Hardwood	1		33	Valley Oak Woodland	3	P	100
Douglas Fir	3	M	33	Montane Hardwood	2	M	33	Valley Oak Woodland	3	S	100
Douglas Fir	3	P	66	Montane Hardwood	2	P	33	Valley Oak Woodland	4	M	100
Douglas Fir	3	S	66	Montane Hardwood	2	S	33	Valley Oak Woodland	4	P	100
Douglas Fir	4	D	33	Montane Hardwood	2		33	Valley Oak Woodland	4	S	100
Douglas Fir	4	M	33	Montane Hardwood	3	M	33	Valley Oak Woodland	4		100
Douglas Fir	4	P	66	Montane Hardwood	3	P	66	Valley Oak Woodland	5	M	100
Douglas Fir	4	S	66	Montane Hardwood	3	S	66	Valley Oak Woodland	5	P	100

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Douglas Fir	5	D	33	Montane Hardwood	3		33	Valley Oak Woodland	5	S	100
Douglas Fir	5	M	33	Montane Hardwood	4	M	33	Valley Oak Woodland	5		100
Douglas Fir	5	P	66	Montane Hardwood	4	P	66	Valley Foothill Riparian	1		66
Douglas Fir	5	S	66	Montane Hardwood	4	S	66	Valley Foothill Riparian	2	D	33
Douglas Fir	6		33	Montane Hardwood	4		33	Valley Foothill Riparian	2	M	66
Dryland Grain Crops			33	Montane Hardwood	5	M	33	Valley Foothill Riparian	2	P	66
Deciduous Orchard			33	Montane Hardwood	5	P	66	Valley Foothill Riparian	2	S	66
Evergreen Orchard		S	33	Montane Hardwood	5	S	66	Valley Foothill Riparian	2		66
Eastside Pine	1		66	Montane Hardwood	5		33	Valley Foothill Riparian	3	M	66
Eastside Pine	2	M	33	Montane Hardwood	6		66	Valley Foothill Riparian	3	P	66
Eastside Pine	2	P	66	Montane Riparian	1		66	Valley Foothill Riparian	3	S	66
Eastside Pine	2	S	66	Montane Riparian	2	D	33	Valley Foothill Riparian	3		66
Eastside Pine	3	M	33	Montane Riparian	2	M	33	Valley Foothill Riparian	4	M	66
Eastside Pine	3	P	66	Montane Riparian	2	P	66	Valley Foothill Riparian	4	P	66
Eastside Pine	3	S	66	Montane Riparian	2	S	66	Valley Foothill Riparian	4	S	66
Eastside Pine	4	M	33	Montane Riparian	2		33	Valley Foothill Riparian	4		66
Eastside Pine	4	P	66	Montane Riparian	3	D	33	Valley Foothill Riparian	5	M	66
Eastside Pine	4	S	66	Montane Riparian	3	M	33	Valley Foothill	5	P	66

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
								Riparian			
Eastside Pine	5	M	33	Montane Riparian	3	P	66	Valley Foothill Riparian	5	S	66
Eastside Pine	5	P	66	Montane Riparian	3	S	66	Valley Foothill Riparian	5		66
Eastside Pine	5	S	66	Montane Riparian	3		33	White Fir	1		66
Eucalyptus	2	M	33	Montane Riparian	4	D	33	White Fir	2	M	66
Eucalyptus	2	P	66	Montane Riparian	4	M	33	White Fir	2	P	66
Eucalyptus	2	S	66	Montane Riparian	4	P	66	White Fir	2	S	66
Eucalyptus	3	M	33	Montane Riparian	4	S	66	White Fir	2		66
Eucalyptus	3	P	66	Montane Riparian	4		33	White Fir	3	M	33
Eucalyptus	3	S	66	Montane Riparian	5	D	33	White Fir	3	P	66
Eucalyptus	4	M	33	Montane Riparian	5	M	33	White Fir	3	S	66
Eucalyptus	4	P	66	Montane Riparian	5	P	66	White Fir	3		33
Eucalyptus	4	S	66	Montane Riparian	5	S	66	White Fir	4	M	33
Eucalyptus	5	M	33	Orchard - Vineyard			33	White Fir	4	P	66
Eucalyptus	5	P	66	Pasture			66	White Fir	4	S	66
Eucalyptus	5	S	66	Perennial Grassland		D	66	White Fir	4		33
Fresh Emergent Wetland		P	66	Perennial Grassland		M	66	White Fir	5	M	33
Fresh Emergent Wetland		S	66	Perennial Grassland		P	66	White Fir	5	P	66
Fresh Emergent Wetland		M	66	Perennial Grassland		S	66	White Fir	5	S	66
Hardwood			33					White Fir	5		33
Irrigated Row and Field Crops			33					Wet Meadow		D	66
Irrigated Hayfield			33					Wet Meadow		M	66
								Wet Meadow		P	66
								Wet Meadow		S	66

Racer (*Coluber constrictor*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
								Wet Meadow	1		66
								Wet Meadow	2		66

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Aspen	1		22	Eucalyptus	2	D	33	Pinyon-Juniper	2	M	33
Aspen	2	M	22	Eucalyptus	2	M	33	Pinyon-Juniper	2	P	66
Aspen	2	P	22	Eucalyptus	2	P	33	Pinyon-Juniper	2	S	66
Aspen	2	S	22	Eucalyptus	2	S	33	Pinyon-Juniper	3	M	33
Aspen	3	M	22	Eucalyptus	3	D	33	Pinyon-Juniper	3	P	66
Aspen	3	P	22	Eucalyptus	3	M	33	Pinyon-Juniper	3	S	66
Aspen	3	S	22	Eucalyptus	3	P	33	Pinyon-Juniper	3		33
Aspen	4	P	22	Eucalyptus	3	S	33	Pinyon-Juniper	4	M	22
Aspen	4	S	22	Eucalyptus	4	D	33	Pinyon-Juniper	4	P	44
Bitterbrush			22	Eucalyptus	4	M	33	Pinyon-Juniper	4	S	44
Blue Oak-Foothill Pine	1		100	Eucalyptus	4	P	33	Pinyon-Juniper	4		22
Blue Oak-Foothill Pine	2	D	44	Eucalyptus	4	S	33	Pinyon-Juniper	5	M	22
Blue Oak-Foothill Pine	2	M	55	Eucalyptus	5	D	33	Pinyon-Juniper	5	P	44
Blue Oak-Foothill Pine	2	P	89	Eucalyptus	5	M	33	Pinyon-Juniper	5	S	44
Blue Oak-Foothill Pine	2	S	100	Eucalyptus	5	P	33	Palm Oasis			22
Blue Oak-Foothill Pine	3	D	44	Eucalyptus	5	S	33	Ponderosa Pine	1		44
Blue Oak-Foothill Pine	3	M	55	Hardwood			33	Ponderosa Pine	2	M	33
Blue Oak-Foothill Pine	3	P	89	Jeffrey Pine	1		33	Ponderosa Pine	2	P	66
Blue Oak-Foothill Pine	3	S	89	Jeffrey Pine	2	P	33	Ponderosa Pine	2	S	66
Blue Oak-Foothill Pine	4	D	44	Jeffrey Pine	2	S	33	Ponderosa Pine	2		33
Blue Oak-Foothill	4	M	45	Jeffrey Pine	3	P	33	Ponderosa Pine	3	M	33

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Pine											
Blue Oak-Foothill Pine	4	P	56	Jeffrey Pine	3	S	33	Ponderosa Pine	3	P	66
Blue Oak-Foothill Pine	4	S	67	Jeffrey Pine	4	P	22	Ponderosa Pine	3	S	66
Blue Oak-Foothill Pine	5	D	44	Jeffrey Pine	4	S	22	Ponderosa Pine	3		33
Blue Oak-Foothill Pine	5	M	45	Jeffrey Pine	5	P	22	Ponderosa Pine	4	M	22
Blue Oak-Foothill Pine	5	P	56	Jeffrey Pine	5	S	22	Ponderosa Pine	4	P	55
Blue Oak-Foothill Pine	5	S	67	Juniper	1		44	Ponderosa Pine	4	S	55
Blue Oak Woodland	1		100	Juniper	2	M	33	Ponderosa Pine	4		22
Blue Oak Woodland	2	M	55	Juniper	2	P	66	Ponderosa Pine	5	M	22
Blue Oak Woodland	2	P	89	Juniper	2	S	66	Ponderosa Pine	5	P	55
Blue Oak Woodland	2	S	100	Juniper	2		33	Ponderosa Pine	5	S	55
Blue Oak Woodland	3	D	33	Juniper	3	M	33	Ponderosa Pine	5		22
Blue Oak Woodland	3	M	55	Juniper	3	P	66	Ponderosa Pine	6		22
Blue Oak Woodland	3	P	89	Juniper	3	S	66	Redwood	1		44
Blue Oak Woodland	3	S	89	Juniper	3		33	Redwood	2	M	33
Blue Oak Woodland	4	D	33	Juniper	4	M	22	Redwood	2	P	66
Blue Oak Woodland	4	M	45	Juniper	4	P	44	Redwood	2	S	66
Blue Oak Woodland	4	P	56	Juniper	4	S	44	Redwood	3	D	33
Blue Oak Woodland	4	S	67	Juniper	4		22	Redwood	3	M	33
Blue Oak Woodland	5	D	33	Juniper	5	M	22	Redwood	3	P	33
Blue Oak Woodland	5	M	45	Juniper	5	P	44	Redwood	3	S	66
Blue Oak Woodland	5	P	56	Juniper	5	S	44	Redwood	4	D	22
Blue Oak Woodland	5	S	67	Juniper	5		22	Redwood	4	M	22
Coastal Oak	1		100	Klamath Mixed	1		44	Redwood	4	P	22

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Woodland				Conifer							
Coastal Oak Woodland	2	M	55	Klamath Mixed Conifer	2	M	33	Redwood	4	S	44
Coastal Oak Woodland	2	P	89	Klamath Mixed Conifer	2	P	66	Redwood	5	P	22
Coastal Oak Woodland	2	S	100	Klamath Mixed Conifer	2	S	66	Redwood	5	S	44
Coastal Oak Woodland	3	M	55	Klamath Mixed Conifer	2		33	Sagebrush			22
Coastal Oak Woodland	3	P	89	Klamath Mixed Conifer	3	M	33	Sierran Mixed Conifer	1		44
Coastal Oak Woodland	3	S	89	Klamath Mixed Conifer	3	P	66	Sierran Mixed Conifer	2	M	33
Coastal Oak Woodland	4	M	45	Klamath Mixed Conifer	3	S	66	Sierran Mixed Conifer	2	P	66
Coastal Oak Woodland	4	P	56	Klamath Mixed Conifer	3		33	Sierran Mixed Conifer	2	S	66
Coastal Oak Woodland	4	S	67	Klamath Mixed Conifer	4	M	33	Sierran Mixed Conifer	2		33
Coastal Oak Woodland	5	M	45	Klamath Mixed Conifer	4	P	55	Sierran Mixed Conifer	3	M	33
Coastal Oak Woodland	5	P	56	Klamath Mixed Conifer	4	S	55	Sierran Mixed Conifer	3	P	66
Coastal Oak Woodland	5	S	67	Klamath Mixed Conifer	4		33	Sierran Mixed Conifer	3	S	66
Closed-Cone Pine-Cypress	1		44	Klamath Mixed Conifer	5	M	22	Sierran Mixed Conifer	3		33
Closed-Cone Pine-Cypress	2	M	33	Klamath Mixed Conifer	5	P	44	Sierran Mixed Conifer	4	D	33
Closed-Cone Pine-Cypress	2	P	66	Klamath Mixed Conifer	5	S	44	Sierran Mixed Conifer	4	M	33
Closed-Cone Pine-Cypress	2	S	66	Klamath Mixed Conifer	5		22	Sierran Mixed Conifer	4	P	55

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Closed-Cone Pine-Cypress	3	M	33	Mixed Chaparral		D	77	Sierran Mixed Conifer	4	S	55
Closed-Cone Pine-Cypress	3	P	66	Mixed Chaparral		M	100	Sierran Mixed Conifer	4		33
Closed-Cone Pine-Cypress	3	S	66	Mixed Chaparral		P	100	Sierran Mixed Conifer	5	D	33
Closed-Cone Pine-Cypress	4	M	22	Mixed Chaparral		S	77	Sierran Mixed Conifer	5	M	33
Closed-Cone Pine-Cypress	4	P	44	Montane Chaparral		S	77	Sierran Mixed Conifer	5	P	55
Closed-Cone Pine-Cypress	4	S	44	Montane Chaparral		M	100	Sierran Mixed Conifer	5	S	55
Closed-Cone Pine-Cypress	5	M	22	Montane Hardwood-Conifer	1		44	Sierran Mixed Conifer	5		33
Closed-Cone Pine-Cypress	5	P	44	Montane Hardwood-Conifer	2	M	33	Sierran Mixed Conifer	6		33
Closed-Cone Pine-Cypress	5	S	44	Montane Hardwood-Conifer	2	P	66	Urban			100
Chamise-Redshank Chaparral		S	77	Montane Hardwood-Conifer	2	S	66	Valley Oak Woodland	2	M	55
Chamise-Redshank Chaparral		M	100	Montane Hardwood-Conifer	3	M	33	Valley Oak Woodland	2	P	89
Coastal Scrub			66	Montane Hardwood-Conifer	3	P	66	Valley Oak Woodland	2	S	100
Douglas Fir	1		44	Montane Hardwood-Conifer	3	S	66	Valley Oak Woodland	3	M	55
Douglas Fir	2	M	33	Montane Hardwood-Conifer	4	M	22	Valley Oak Woodland	3	P	89
Douglas Fir	2	P	66	Montane Hardwood-Conifer	4	P	44	Valley Oak Woodland	3	S	89
Douglas Fir	2	S	66	Montane Hardwood-Conifer	4	S	44	Valley Oak Woodland	4	M	45
Douglas Fir	3	D	22	Montane Hardwood-Conifer	5	M	22	Valley Oak Woodland	4	P	56

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Douglas Fir	3	M	33	Montane Hardwood-Conifer	5	P	44	Valley Oak Woodland	4	S	67
Douglas Fir	3	P	66	Montane Hardwood-Conifer	5	S	44	Valley Oak Woodland	4		45
Douglas Fir	3	S	66	Montane Hardwood	1		44	Valley Oak Woodland	5	M	45
Douglas Fir	4	D	22	Montane Hardwood	2	M	33	Valley Oak Woodland	5	P	56
Douglas Fir	4	M	22	Montane Hardwood	2	P	66	Valley Oak Woodland	5	S	67
Douglas Fir	4	P	44	Montane Hardwood	2	S	66	Valley Oak Woodland	5		45
Douglas Fir	4	S	44	Montane Hardwood	2		33	Valley Foothill Riparian	1		44
Douglas Fir	5	D	22	Montane Hardwood	3	D	33	Valley Foothill Riparian	2	D	66
Douglas Fir	5	M	22	Montane Hardwood	3	M	33	Valley Foothill Riparian	2	M	66
Douglas Fir	5	P	44	Montane Hardwood	3	P	66	Valley Foothill Riparian	2	P	89
Douglas Fir	5	S	44	Montane Hardwood	3	S	66	Valley Foothill Riparian	2	S	100
Desert Riparian	2	D	22	Montane Hardwood	3		33	Valley Foothill Riparian	2		66
Desert Riparian	2	M	22	Montane Hardwood	4	D	33	Valley Foothill Riparian	3	D	66
Desert Riparian	2	P	22	Montane Hardwood	4	M	33	Valley Foothill Riparian	3	M	66
Desert Riparian	2	S	22	Montane Hardwood	4	P	66	Valley Foothill Riparian	3	P	89
Desert Riparian	3	P	22	Montane Hardwood	4	S	66	Valley Foothill Riparian	3	S	77
Desert Riparian	3	S	22	Montane Hardwood	4		33	Valley Foothill Riparian	3		66

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
Desert Riparian	4	P	22	Montane Hardwood	5	D	33	Valley Foothill Riparian	4	D	66
Desert Riparian	4	S	22	Montane Hardwood	5	M	33	Valley Foothill Riparian	4	M	66
Desert Riparian	5	P	22	Montane Hardwood	5	P	66	Valley Foothill Riparian	4	P	89
Desert Riparian	5	S	22	Montane Hardwood	5	S	66	Valley Foothill Riparian	4	S	89
Eastside Pine	1		44	Montane Hardwood	5		33	Valley Foothill Riparian	4		66
Eastside Pine	2	M	33	Montane Hardwood	6		66	Valley Foothill Riparian	5	D	66
Eastside Pine	2	P	66	Montane Riparian	1		44	Valley Foothill Riparian	5	M	44
Eastside Pine	2	S	66	Montane Riparian	2	M	33	Valley Foothill Riparian	5	P	66
Eastside Pine	3	M	33	Montane Riparian	2	P	66	Valley Foothill Riparian	5	S	66
Eastside Pine	3	P	66	Montane Riparian	2	S	66	Valley Foothill Riparian	5		44
Eastside Pine	3	S	66	Montane Riparian	2		33	Valley Foothill Riparian	6		66
Eastside Pine	4	M	22	Montane Riparian	3	M	33	White Fir	1		44
Eastside Pine	4	P	44	Montane Riparian	3	P	66	White Fir	2	M	33
Eastside Pine	4	S	44	Montane Riparian	3	S	66	White Fir	2	P	66
Eastside Pine	5	M	22	Montane Riparian	3		33	White Fir	2	S	66
Eastside Pine	5	P	44	Montane Riparian	4	M	22	White Fir	2		33
Eastside Pine	5	S	44	Montane Riparian	4	P	44	White Fir	3	M	33
				Montane Riparian	4	S	44	White Fir	3	P	66
				Montane Riparian	4		22	White Fir	3	S	66
				Montane Riparian	5	M	22	White Fir	3		33

Spotted towhee (*Pipilo maculatus*)

WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score	WHR NAME	Size	Density	Habitat Score
				Montane Riparian	5	P	44	White Fir	4	M	33
				Montane Riparian	5	S	44	White Fir	4	P	55
								White Fir	4	S	55
								White Fir	4		33
								White Fir	5	M	22
								White Fir	5	P	44
								White Fir	5	S	44
								White Fir	5		22