DEVELOPMENT OF MINERAL SITE COUNTS TO RELIABLY INDEX THE PACIFIC COAST BREEDING POPULATION OF BAND-TAILED PIGEONS

Photo by Jennifer Gibson

FINAL REPORT

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USGS
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DEVELOPMENT OF MINERAL SITE COUNTS TO RELIABLY INDEX THE PACIFIC COAST BREEDING POPULATION OF BAND-TAILED PIGEONS

FINAL REPORT

Webless Migratory Game Bird Research Program

March 2001

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EXECUTIVE SUMMARY

The Pacific Coast population of band-tailed pigeons (*Columba fasciata monilis*) is a unique and highly nomadic webless migratory bird, that was once a highly prized game species in this region. Their status as a game species has been diminished in recent years. As estimated by the North American Breeding Bird Survey (BBS), the Pacific Coast population of band-tailed pigeons has declined markedly. However, BBS data are not precise enough to produce reliable indices for short term and year-to-year fluctuations, and no population index exists which can produce these estimates for band-tailed pigeons. Development of such a survey has been a top priority research need for many years. The objectives of this study were to 1) document the timing and use of mineral sites by band-tailed pigeons and relate feeding and nesting areas to mineral site location, 2) compare to the known use of sites in Oregon 3) examine habitat use of pigeons within each study area 4) to begin development of a comprehensive breeding survey using mineral counts in California, Oregon, Washington and British Columbia.

We used radio telemetry to quantify and document mineral site use by radio-marked individuals. We captured and radio-marked 79 adult band-tailed pigeons using rocket nets and bait traps at four different mineral sites (Willow Creek & Need Camp, in Shasta County, and Spanish Creek & Indian Creek, in Plumas County, CA). Birds were weighed and measured (culmen, tarsus, wing- cord), fitted with backpack transmitters, and released at the point of capture. Males were generally larger than females, with a larger mean weight, bill and longer wing chord.

Birds were tracked using standard vehicle and hand-held telemetry techniques. Pigeons were located on a daily basis with a goal of 2 locations in each of three time periods each week. Habitat description and status of bird (feeding, on nest, at known mineral site etc.) were recorded for each location. Data loggers were stationed at each of the four capture locations to continually scan and record visits by radio-marked pigeons. During the 1999 field season many of the birds left the primary study area shortly after marking. All but one of the birds marked at Willow Creek left the area within ten days. Overall, about half of the Redding and half of the Quincy birds left the area. Subsequent aerial telemetry searches determined the birds had left the immediate area (150 km radius) and likely had migrated into Oregon or farther north. One radio-marked bird from the Willow Creek site was located in Oregon on August 21, 1999, approximately 400 km from its capture location. We marked birds two weeks later in 2000 and a higher proportion remained in the study area for a longer period.

The radio-marked birds did not use mineral sites on a consistent basis either year. However, the data loggers did not function properly during parts of the study and this coupled with reduced sample size due to migrating birds, limited our ability to detect use of mineral springs by marked individuals, especially during the first field season. Of the birds we tracked on a regular basis, 17 were located at mineral sites on at least one occasion, while almost all were detected at mineral sites by the data loggers on at least one occasion. No more than four radio-marked individuals visited any one mineral site on any given day, and was usually two or less. On average, birds in the Quincy study area visited a known mineral site about once every 21 days, while use of the Redding sites was much less consistent with radio-marked individuals detected at the mineral sites only once or twice during the course of the field season.

Home range estimates for the Redding site averaged 4,454 ha while home range estimates for the Quincy site averaged 6,032 ha. Compositional analysis of habitat use data indicated that dense canopy cover was highly represented within individual home ranges with respect to study area. Habitat use by individuals within their home ranges suggests that the tree stand category of 'small trees' was an important habitat type with respect to availability. At least five of the birds marked in the Quincy area frequented back-yard feeders and could be located in and around urban areas on a regular basis. We found 5 nests in the Redding study area, all of which were within 6.6 km of the known mineral site at Need Camp. We found 9 nests of radio marked birds in the Quincy study area. These nests ranged from .6 km to 11.5 km from known mineral sites, with a mean of 4.0 km. The nests were located in several different tree species including Douglas Fir (*Pseudotsuga menziesii*), Canyon Live Oak (*Quercus chrysolepis*), and Tanoak (*Lithocarpus densiflorus*). Several of the other radio-marked pigeons were suspected to be nesting in the area, but topography and dense vegetation precluded finding their nests.

The development of a comprehensive population index for Pacific band-tailed pigeons using visual counts at mineral sites requires that we select appropriate sites for inclusion into the survey. A buffer should be established between known mineral sites to reduce the chance of misrepresenting the importance of a given area and maintain independence between counts. Home range sizes or average distances from nest to feeding sites may be appropriate for use in calculating buffer size. Determining the proper timing and distribution of mineral site surveys is also critical to reduce variability and improve precision of the survey. Band-tailed pigeons have a high fidelity to breeding areas and their local movements within these areas indicate an important link with mineral sites. The information gathered in this study supports the concept that mineral sites offer a window into the local breeding population of band-tailed pigeons and may provide the basis for a reliable and powerful population index.

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LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

INTRODUCTION

A reliable index of population size is fundamental to sound management of any species. Band-tailed pigeons (*Columba fasciata*), a game bird species distributed in two regions in North America, has long been identified as lacking a reliable population index (Einarsen 1954, Keppie et al. 1971, Western Migratory Upland Game Bird Tech. Comm. 1994, Braun 1994, Keppie and Braun 2000). A reliable population index would offer resource managers the ability to evaluate the effectiveness of habitat management efforts, set harvest regulations, and monitor other effects, such as disease, on the population.

Two subspecies of band-tailed pigeons breed in North America; Pacific Coast band-tailed pigeons (*Columba fasciata monilis*) and the Interior or “Four Corners” population of band-tailed pigeons (*Columba fasciata fasciata*). Banding records indicate some interchange between the two populations (Keppie and Braun 2000). Currently, three surveys used to determine population trends in band-tailed pigeons (Casazza et al. 2000). Long-term population trends have been evaluated for both the Interior and Pacific subspecies, using the Breeding Bird Survey (BBS). The BBS is overseen by the US Geological Survey (Biological Resources Division) and the Canadian Wildlife Service, and currently provides annual population data on all North American bird species. Trend estimates from the BBS for the Interior population have been inconclusive due to low sample size and high variability, while trend estimates for the Pacific population have shown an annual 2.0% decrease since 1968 (Casazza et al. 2000). When the Interior and Pacific BBS estimates are combined to evaluate the North American Breeding population estimate, the trend is a 2.8% annual decline since 1966 (Keppie & Braun 2000).

In addition to the BBS survey, the states of Washington and Oregon conduct species-specific surveys to help evaluate the population status of band-tailed pigeons in those States.

Washington conducts call-count routes (Jeffrey 1989) and Oregon uses mineral site counts (Western Migratory Upland Game Bird Tech. Comm. 1994) to derive an index of pigeon numbers in the Pacific Coast region. Sanders (1999) suggests that coo call counts at random points throughout their range may offer a potential survey methodology which would relate abundance of band-tailed pigeons to habitat features. Comparison of the various survey methods including the BBS, Washington call-counts, and mineral site counts, reveals that mineral site counts offer the greatest potential for providing a reliable and powerful index for the Pacific band-tailed pigeon population (Casazza et al. 2000).

Mineral sites such as springs, estuaries, waste water, dissolved livestock salt blocks, and piled road salts, attract pigeons, especially in the Pacific population (Keppie and Braun 2000, Sanders and Jarvis 2000, Jarvis and Passmore 1992, Smith 1968, Neff 1947) Mineral sites, natural and man-made, appear to fulfill important requirements for band-tailed pigeons, possibly providing sodium ions to offset potassium:sodium ion imbalance (Sanders and Jarvis 2000). Early hypotheses suggesting band-tailed pigeons supplement dietary calcium from mineral springs (March and Sadleir 1972, 1975, Jarvis and Passmore 1992) have recently been refuted due to inconsistent calcium concentrations at mineral springs in Oregon (Sanders and Jarvis 2000).

Mineral sites are used almost exclusively in the morning. Morse (1950) reports pigeons using a spring in Oregon during the hunting season between sunrise and 11:00 only. Jarvis and Passmore (1992) indicate pigeon use between daylight and 12:00. Throughout the range of band-tailed pigeons, their use of mineral springs may vary widely in response to food availability (Braun 1994), and may also be affected by human activity, development surrounding the site, availability of perching sites, and tradition of congregation (Sanders and Jarvis 2000).

STUDY AREA

We studied band-tailed pigeons in two areas of Northern California (Figure 1). Whiskeytown National Recreation Area is located approximately 10 miles west of Redding and encompasses Whiskeytown Lake (Redding site). Two mineral sites were used by band-tailed pigeons within the park boundaries, the Need Camp and Willow Creek sites. Chemical analysis of the Need Camp mineral site (Appendix A) indicate high levels of both sodium and calcium. Our second study area is located in Plumas National Forest, near Quincy, California (Quincy site). Two known mineral sites, Spanish Creek, and Indian Creek, were the central focus of study in this region. A third mineral site, Fells Flat, was located to the east of Quincy as a result of radio-tracking one bird to the area.

METHODS

Radio-tracking

We captured band-tailed pigeons at four different mineral sites located in Northern California (Figure 1) using rocket nets and box traps. Birds were aged, sex determined by cloacal examination, weighed, and measured (bill, tarsus, wing). Backpack transmitters (9 g) were attached to 30 females and 49 males using a Teflon harness similar to the description in Leonard (1998). The birds were released at the point of capture and monitored on a daily basis using standard vehicle and hand-held telemetry techniques. Trackers attempted to attain two locations each week in each of three different time periods. An effort was made to determine the activity of the bird at each location (feeding, nesting, etc.).

Trackers attempted to locate nests of radio marked individuals using hand-held antennae and hiking to possible nest sites. When a nest was located we recorded tree species, nest height and orientation in tree, nest concealment, number of eggs or nestlings, and other physiographic measurements (Appendix B). Distance from each nest to nearest known mineral site was determined using Geographic Information System software (Arc View).

Data Loggers

We placed remote data loggers at each of the four mineral (capture) sites to monitor for return visits by marked individuals. The remote loggers were placed in close proximity to the mineral site and situated to detect birds when they visited the mineral site. Data loggers were programmed to scan for all marked individuals every five minutes and record all birds present. We downloaded the data from the data loggers weekly using a laptop computer.

Habitat Use and Home Range

Habitat use analysis was completed for radio-marked birds which remained within each of the two study sites. We created home ranges using the Adaptive Kernel Method (Worton 1989,1995), taking 95% confidence contours using the "LSSCV" method for choosing the smoothing parameter (Tufto et al. 1996) for birds with more than 30 telemetry locations. We used compositional analysis (Aebischer et al. 1993) to test for habitat preference by band-tailed pigeons. We also examined habitat preference for second and third-order selection as described by Johnson (1980). We used a multi-variate analysis of variance (MANOVA) (Johnson and Wichern 1988, SAS Institute, 1989) to test whether a composition of use to availability log ratios was significantly different than zero ($p<0.05$), indicating a preference by pigeons for certain habitat types. We report F-value, degrees of freedom (df), and probability value for each MANOVA test. Habitat delineations for the Redding site included Canopy Closure (Figure 2), Slope (Figure 3), Soil Depth (Figure 4), Forest Stand Type (Figure 5), Forest Stand Composition (Figure 6) Surface Rock Classification (Figure 7) Site Class Symbol [used by US Forest Service in California to represent tree height at 100/300 years based on pine and fir trees present (Figure 8)]. Two habitat classifications were available from the Plumas National Forest, including Tree Characteristics (Figure 9) and Canopy Coverage (Figure 10).

RESULTS

Data Loggers

We used remote data loggers to determine frequency of pigeon use at the mineral sites as well as local use patterns. We found the reliability of these data loggers to accurately detect radio-marked pigeons was affected by interference from two-way radios, power lines, cell phones, and other causes. In addition to interference from outside sources, we experienced problems associated with extremely high ambient temperatures (>42EC) which produced errors in the data logging system and was especially apparent at the warmer Redding site. As a result, there were significant periods of time in which the data could not be used. Some radio-marked pigeons nested fairly close to the data loggers, and these birds were often recorded as visiting the spring when in reality were a short distance away on a nest. Many birds also left the immediate study areas, especially during 1999, and this further reduced sample size during that year. Although these difficulties reduced our sample, we were still able to examine mineral site visits on a limited basis.

We plotted the number of visits by pigeons to the mineral sites on a daily basis from late June through mid September (Figures 11-12). No more than four radio-marked individuals visited any one mineral site on any given day, and was usually two or less. The pattern of visitation was relatively consistent throughout the study period, with only one or two birds visiting a site on almost any given day. On average, birds in the Quincy study area visited a known mineral site about once every 21 days, while use of the Redding sites was much less consistent with radio-marked individuals detected at the mineral sites only once or twice during the course of the field season. We plotted the regression probability of presence at the two Quincy mineral sites and found that distance from centroid of home range was significantly related to the frequency of site visits by pigeons (Figure 13). The quality of the data garnered from data loggers and the difficulty in distinguishing actual site visits from pigeons that were recorded due the close proximity of their nests, make our conclusions tentative.

Home Range

We plotted locations of radio-marked pigeons in both study areas (Figure 14-15). Locations at the Redding study area were clustered on the south side of Whiskeytown Lake, while Quincy area locations are more widespread. Consequently, home range estimates for the Redding site averaged 4,454 ha while home range estimates for the Quincy site were greater and averaged 6,032 ha (Table 1). Males had slightly larger average home range estimates (5,538 ha) than females (4846 ha), while home ranges varied widely between individuals (984 ha to 16,509 ha).

Habitat Use

Second Order Selection

We compared habitat composition of individual home ranges with available habitat types within each study area (Second Order Selection). Home range habitat composition was significantly different from availability for both Tree Stand Type ($p = 0.003$) and Canopy Closure ($p=0.015$) at the Quincy study site (Table 2). The Multi-Layered Canopy composed more than expected of individual pigeon home ranges, while Large Trees was the lowest ranking Tree Stand Type. The highest ranking category for Canopy Closure was 60% or greater, and this habitat made up a greater proportion of individual home ranges than expected, while canopy closure of 0-10% was the lowest ranked category.

Second Order Selection at the Redding site was evaluated for several different habitat variables, all of which demonstrated significant differences between home range composition and habitat availability within the study area (Table 3). We examined 7 variables including Forest Composition, Timber Stand Type, Site Classification, Canopy Cover, Soil Characteristics, Slope, and Soil Depth. Mixed Canopy Stands was the highest ranked category of Forest Composition. Cutover Areas ranked highest for Timber Stand Types, while Old Growth was least represented in the home ranges with respect to availability.

Site Classifications represent predicted tree height at 100/300 years and Rank II and III were significantly higher ranked than Site Class IV (Table 3). The highest ranked Canopy Cover category was >80% while the lowest ranked was 5-20%. The Soil Characteristic variable which primarily refers to amount of surface rock or stone in the soil, that was ranked highest, was the Soil + Stone/Cobble/Gravel; while the lowest ranked type was areas with 2-10% surface rock. We examined Slope, and the mid-range slope of 30-50% was ranked highest. The Soil Depth category indicated that depths of 1-2 feet were ranked highest while shallow soils, 0-1 feet were ranked lowest.

Third Order Selection

We compared habitat use by individual radio-marked pigeons with available habitat within each pigeons home range for both study sites (Third Order Selection). At the Quincy site, both Tree Stand Type ($p = 0.0006$) and Canopy Closure ($p=0.002$) showed significant use patterns (Table 3). The stand type of Large Trees was ranked lower than all other categories and was significantly lower than all other categories except Pole. The canopy closure classification of 40-60% ranked highest while a canopy closure of 10-20% ranked lowest.

Individual habitat use for band-tailed pigeons marked at the Redding site also demonstrated some habitats being used significantly greater than others based on availability in each individual home range (Table 5). For Timber Stand Type, Cutover areas ranked highest in use while Grass, Developed, and Knobcone/inoperable areas ranked lowest. Pigeons used areas with slopes in the 30-70% range and soil depths in the >3 ft. range in greater proportion to availability than the other variables in those categories.

Nesting & Feeding Areas

We found a total of 14 nests between the two study areas, 9 at the Quincy site and 5 at the Redding site. These nests were in fairly close proximity to known mineral sites (Table 6). Of the 14 nests, 6 fledged one young, 2 were unsuccessful and 6 were of unknown fate (Appendix B). Nests were constructed in a variety of tree species including Douglas Fir (*Pseudotsuga menziesii*), Canyon Live Oak (*Quercus chrysolepis*), and Tanoak (*Lithocarpus densiflorus*). Feeding areas ranged anywhere from 50 m to 28 km from the known mineral sites. Mean distances from feeding areas to mineral sites in the Redding area averaged 4 km while in the Quincy area distances averaged a little over 5 km from known mineral sites (Table 6).

DISCUSSION

We investigated band-tailed pigeon use of mineral sites in Northern California in hopes of gaining insight into why pigeons use these sites and how they relate to their life history, primarily during the breeding season. We wanted to compare what we found in California with results from work in Oregon (Jarvis & Passmore 1992, Leonard 1998, Sanders 1999) to try and evaluate the effectiveness of a range-wide population index based on visual counts conducted at mineral sites along the Pacific coast.

Radio-marked individuals were not often found at mineral sites during our study which is consistent with what Leonard (1998) found in the coast range of Oregon. The frequency of their visits was surprisingly low (Figures 11-12). However, the intensity of the use of mineral sites did not fluctuate greatly and this offers promise that variability in visual counts conducted at mineral sites will not be affected by large amounts of daily variation in counts. This is consistent with multiple count data collected in Northern California from 1998-2000 (Casazza et al. 2000).

Leonard (1998) found that MCP home ranges averaged 11,000 ha while we found home ranges to be 5,000 ha using the adaptive kernal method. We also compared home ranges of pigeons that had between 8 and 37 points using the MCP method similar to Leonard (1998) and found that home ranges at our study sites were much smaller, averaging only 2,000 ha. Band-tailed pigeons breeding in California seem to have a much smaller home range than those breeding in Oregon. One reason for these differences may be the timing of nesting and how it relates to forage availability and our period of marking. Leonard (1998) marked birds beginning in April at a time when food resources were limited and birds may have needed to range farther to find forage. Leonard (1998) found that as the season progressed, pigeons traveled shorter distances to feeding areas. Perhaps if we compared home ranges over a similar time period (June - September) we would see home range sizes more closely related. Nesting chronology for band-tailed pigeons in Oregon begins in late April and continues until mid October (Leonard 1998), while the nesting season in California is likely even longer (MacGregor and Smith 1955).

We were limited to marking birds in mid June because of the uncertainty of marking local nesting birds or late migrants. When we marked birds too early, as our initial capture at the Willow Creek mineral site in 1998 demonstrated, birds were more likely to leave the study area and continue migration north. Thus, reducing our sample size and limiting our ability to detect mineral site use. We did observe strong evidence of early breeding at both the Redding and Quincy study sites while we were bait trapping. At one point on June 12, 1999 we captured 13 hatch year birds in a single trap at the Quincy site and on June 6, 1999 we captured 2 hatch year birds at the Willow Creek site as well. Therefore, we were likely marking birds that were well into the breeding season and may have had less reason to search great distances for food resources or nesting sites and in turn had smaller home ranges.

Band-tailed pigeons do exhibit philopatry to nesting areas (Jarvis and Passmore 1992, Schroeder & Braun 1993, Leonard 1998). Jarvis and Passmore (1992) reported that 74% of adult females and 62% of adult males were resighted at the same mineral site where captured the previous year, while Leonard (1998) observed that 4 of 7 pigeons that he was able to track for 2 consecutive summers, nested less than 1 km from their previous nest. We did recapture two of our marked birds the following year and found them to be utilizing the same area as the previous year. Philopatry to nesting areas is potentially very important with respect to using visual counts at mineral sites to index the population. Nesting pigeons traveled between 3.5-14 km to utilize mineral sites that were at the nearest known site to their nest (Leonard 1998). We found that radio-marked pigeons which remained in our study area had home ranges with centroids that ranged from 1-25 km of known mineral sites. We also found some evidence that suggests the closer a pigeons home range is to a mineral site, the more likely it will be to recorded visiting that site (Figure 13). Consistency of use of mineral sites by band-tailed pigeons between years as evidenced by the strong tendency for philopatry to nesting areas suggests that visual counts at mineral sites offer the potential of a more stable index with less variability than other indexes such as the BBS or Washington Call-Count Routes (Casazza et al. 2000).

Nest site selection in California was similar to that found in Oregon (Leonard 1998), with most of the nests found in Douglas-fir trees and a smaller portion found in deciduous trees (Appendix B). Habitat use was also somewhat similar between Oregon and California. Leonard (1998) found that pigeons used almost every type of forest stand classification except shrubland areas for nesting in Oregon. He also speculated that pigeons were nesting in habitats in proportion to their availability, with a majority of nests found in the conifer, closed sappling-pole forest stand classification. We found that large trees and old growth made up smaller proportions of pigeon home ranges than would be expected (Tables 2-3), and that habitat use within home ranges (Tables 4-5) indicated that cutover and small hardwood areas were highly ranked and old growth areas were not used as much as expected. The habitat rankings for third order selection included areas used for both nesting and feeding, and the rankings should be interpreted as such. The top ranked habitats may have been used by either feeding or nesting birds while the lower ranked habitats may have had minimal importance for nesting or feeding, or both.

The development of a comprehensive population index for Pacific band-tailed pigeons using visual counts at mineral sites requires that we select appropriate sites for inclusion into the survey. We plotted all known mineral sites in Washington, Oregon and California (Figure 16) (Savage 1993, Todd Sanders pers. comm.) for use as a base map from which to design a comprehensive survey. Comparing known mineral site locations with known breeding range (Keppie and Braun 2000), results in obvious regions for further investigation of possible inclusion into a comprehensive breeding survey. These areas include the southwest coast of British Columbia and the central and north coast of California as well as the Sierra Nevada mountains south of Plumas County. Mineral sites existing within these regions should be identified for inclusion into the survey. In addition, mineral sites in close proximity to other mineral sites should be evaluated before inclusion into the breeding index. A minimum buffer should be established to reduce chances of over or under-estimating the importance of a given area (Figure 17). Home range sizes or average distances from nest to feeding sites may be appropriate for use in calculating buffer size around mineral sites included in the survey.

Determining the proper timing of mineral site surveys is also critical to reduce variability and improve precision of the survey (Casazza et al. 2000). Mineral site surveys in Oregon are completed at the end of August or early September each year. Data from California suggests that mineral site counts are more stable during the middle of summer (July) and may be more indicative of the local breeding population and less inclusive of recent migrants (Casazza et al. 2000). The information gathered in this study supports the concept that mineral sites offer a window into the local breeding population of band-tailed pigeons and may provide the basis for a reliable and powerful population index.

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Table 1. Home range estimates and comparisons.

Adaptive Kernal (30+ points)		n	mean	std dev	min	max
Quincy:	Males	10	6689.4	4808.949	1654	16509
	Females	6	4937.333	3127.64	1443	10728
	Total	16	6032.375	4231.281		
Redding:	Males	13	4651.615	2548.515	984	10586
	Females	8	4133.875	2156.343	1699	8161
	Total	21	4454.381	2364.481		
All:	Males	23	5537.609	3751.024	984	16509
	Females	14	4846.333	2830.069	1443	10728
	Total	37	5264.737	3393.207		
MCP (8-37 points)		**n**	**mean**	**std dev**	**min**	**max**
Quincy:	Males	9	1913.667	2041.717	105	6426
	Females	6	2887.714	3719.902	62	10936
	Total	15	2339.813	2829.731		
Redding:	Males	4	1138.5	885.8177	314	1970
	Females	N/A	N/A	N/A	N/A	N/A
	Total	4	1138.5	885.8177		
All:	Males	13	1675.154	1764.627	105	6426
	Females	6	2887.714	3719.902	62	10936
	Total	19	2099.55	2586.227		
MCP (30+ points)		**n**	**mean**	**std dev**	**min**	**max**
Quincy:	Males	10	5414.9	4309.672	749	12648
	Females	6	6513.5	3945.389	2628	11036
	Total	16	5828.875	4078.528		
Redding:	Males	12	4656.333	3541.808	1155	12521
	Females	9	3701.111	1521.037	1253	6076
	Total	21	4246.952	2838.921		
All:	Males	22	5001.136	3831.49	749	12648
	Females	15	4826.067	2985.838	1253	11036
	Total	37	4930.162	3469.603		

Table 2. Second order selection using compositional analysis for band-tailed pigeons radio-marked at the Quincy study site ("=0.05).

Habitat Variable	P Value	F Statistic	8	df
Tree Stand Type	0.0026	7.12	0.252	5
Rank: Multi-layered canopy$^{\mathrm{AB}}$>Pole$^{\mathrm{aB}}$>Small Trees$^{\mathrm{aB}}$> Grass and Shrubs$^{\mathrm{aB}}$>Saplings$^{\mathrm{aB}}$>Large Trees$^{\mathrm{ab}}$				
Canopy Closure	0.0151	4.64	0.412	4
Rank: 60%+$^{\mathrm{A}}$>20%-40%$^{\mathrm{a}}$>10%-20%$^{\mathrm{a}}$>40%-60%$^{\mathrm{a}}$>0%-10%$^{\mathrm{a}}$				

$^{\mathrm{A}}$indicates significantly higher ranking than $^{\mathrm{a}}$
$^{\mathrm{B}}$indicates significantly higher ranking than $^{\mathrm{b}}$

Table 3. Second order selection using compositional analysis for band-tailed pigeons radio-marked at the Redding study site ("=0.05).

Habitat Variable	P Value	F Statistic	8	df
Forest Composition	<0.0001	43.85	0.178	2
Rank: Mixed canopy stands^{A}>Other^{a}>Conifer dominated stands^{a}				
Timber Stand Types	<0.0001	49.88	0.039	7
Rank: Cutover^{ABCDE}>Large Hardwoods^{ABCDE}>Young Growth^{ABCDE}>Grass^{aCDE}> Developed^{bDE}>Knobcone/Inoperable Areas^{c}>Small Hardwoods^{d}>Old Growth^{e}				
Site classifications	<0.0001	17.51	0.352	2
Rank: II (122'/175')^{A}>III (102'/150')^{A}>IV (67'-100')^{a}				
Canopy Cover	<0.0001	395.78	0.011	4
Rank: 80%+^{ABC}>50%-80%^{ABC}>0%-5%^{aC}>20%-50%^{bC}>5%-20%^{c}				
Soil Characteristics	<0.0001	29.25	0.245	2
Rank: Soil 20%+ Stone/Cobble/Gravel^{A}>Surface Rock 10%-50%^{A}> Surface Rock 2%-10%^{a}				
Slope	<0.0001	96.10	0.059	3
Rank: 30%-50%^{AB}>0%-30%^{aB}>70%+>50%-70%^{ab}				
Soil Depth	<0.0001	106.38	0.038	4
Rank: 1'-2'^{ABCD}>2'-3'^{aCD}>3'-4'^{bCD}>4'+^{c}>0'-1'^{d}				

^{A}indicates significantly higher ranking than ^{a}
^{B}indicates significantly higher ranking than ^{b}
^{C}indicates significantly higher ranking than ^{c}
^{D}indicates significantly higher ranking than ^{d}
^{E}indicates significantly higher ranking than ^{e}

Table 4. Third order selection using compositional analysis for band-tailed pigeons radio-marked at the Quincy study site ("=0.05).

Habitat Variable	P Value	F Statistic	8	df
Tree Stand Type	0.0006	9.91	0.195	5
Rank: Small Trees[AB]>Grass and Shrubs[B]>Multi-layered canopy[B]>Saplings[B]>Pole[a]> Large Trees[ab]				
Canopy Closure	0.0019	7.89	0.292	4
Rank: 40%-60%[A]>20%-40%>0%-10%>60%+>10%-20%[a]				

[A]indicates significantly higher ranking than [a]
[B]indicates significantly higher ranking than [b]

Table 5. Third order selection using compositional analysis for band-tailed pigeons radio-marked at the Redding study site ("=0.05).

Habitat Variable	P Value	F Statistic	8	df
Forest Composition	0.0052	7.04	0.574	2
Rank: Conifer dominated stands^{A}>Mixed canopy stands^{A}>Other^{a}				
Timber Stand Types	0.0089	4.40	0.313	7
Rank: Cutover^{ABCD}>Small Hardwoods^{BCD}>Large Hardwoods^{D}>Young Growth^{D}>Old Growth^{a}>Grass^{b}>Developed^{c}>Knobcone/Inoperable Areas^{d}				
Site classifications	0.0747	2.98	0.761	2
Rank: II (122'/175')^{A}>III (102'/150')^{A}>IV (67'-100')^{a}				
Canopy Cover	0.2746	1.38	0.873	2
Rank: 50%-80%>80%+>0%-50%				
Soil Characteristics	0.0060	9.45	0.679	1
Rank: Soil 20%+ Stone/Cobble/Gravel^{A}> Surface Rock 2%-50%^{a}				
Slope	0.0127	4.79	0.556	3
Rank: 50%-70%$^{A>}$30%-50%^{A}>0%-30%>70%+^{a}				
Soil Depth	0.0060	6.78	0.583	2
Rank: 3'+^{AB}>2'-3'^{a}>0'-2'^{b}				

^{A}indicates significantly higher ranking than ^{a}
^{B}indicates significantly higher ranking than ^{b}
^{C}indicates significantly higher ranking than ^{c}
^{D}indicates significantly higher ranking than ^{d}

Table 6. Distance to springs; nests and feeding locations (distances in meters).

Nest	n	mean	std dev	min	max
Redding	5	4001	1978	1810	6620
Quincy	9	4028	3861	675	11525
All	14	4018	3221	675	11525

Feeding	n	mean	std dev	min	max
Redding	799	3969	2419	117	28360
Quincy	874	5329	4345	43	19437
All	1673	4679	3621	43	28360

Figure 1. Study Areas.

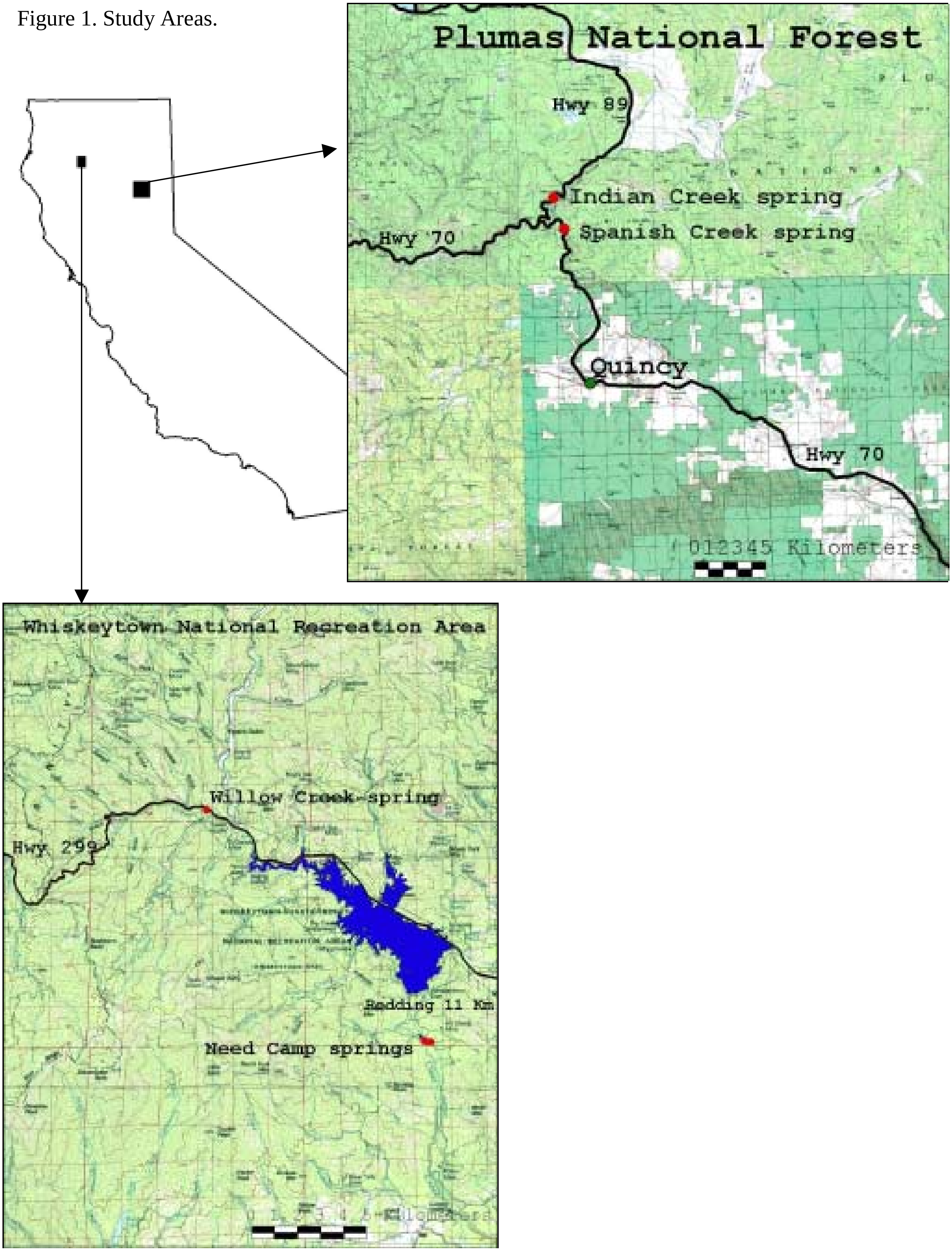


Figure 2. Canopy coverage, Whiskeytown National Recreation Area.

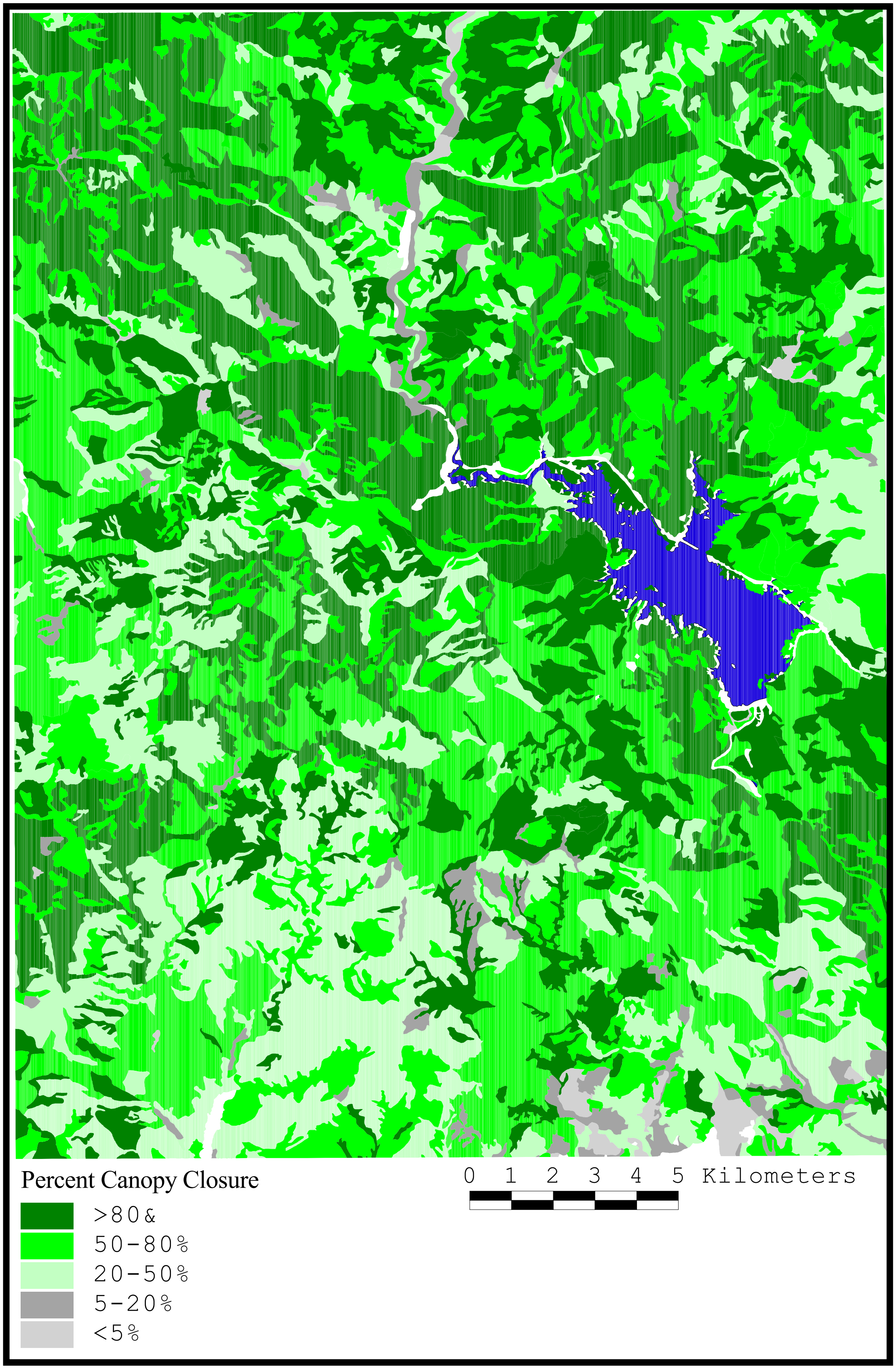


Figure 3. Slope, Whiskeytown National Recreation Area.

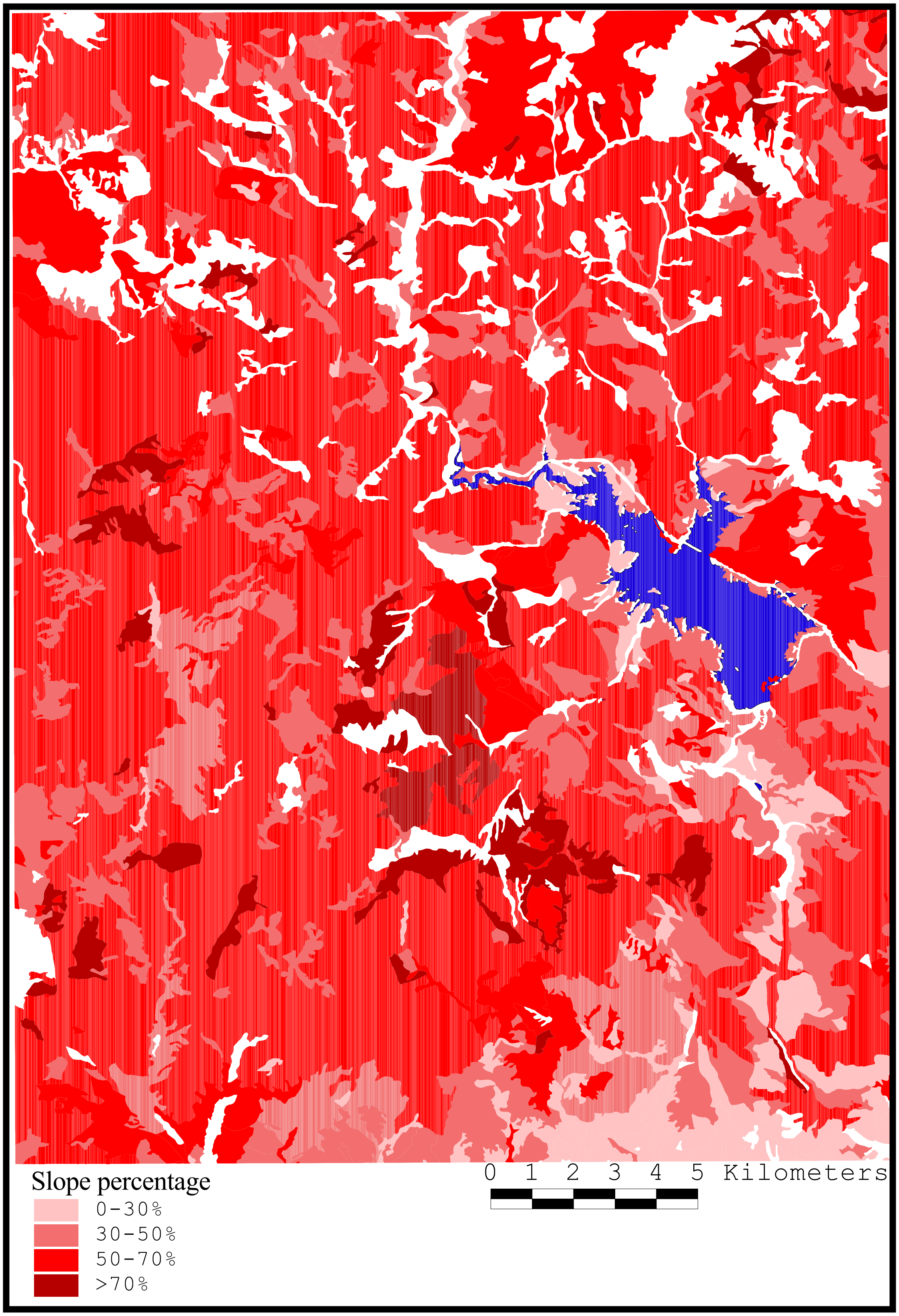


Figure 4. Average soil depth, Whiskeytown National Recreation Area.

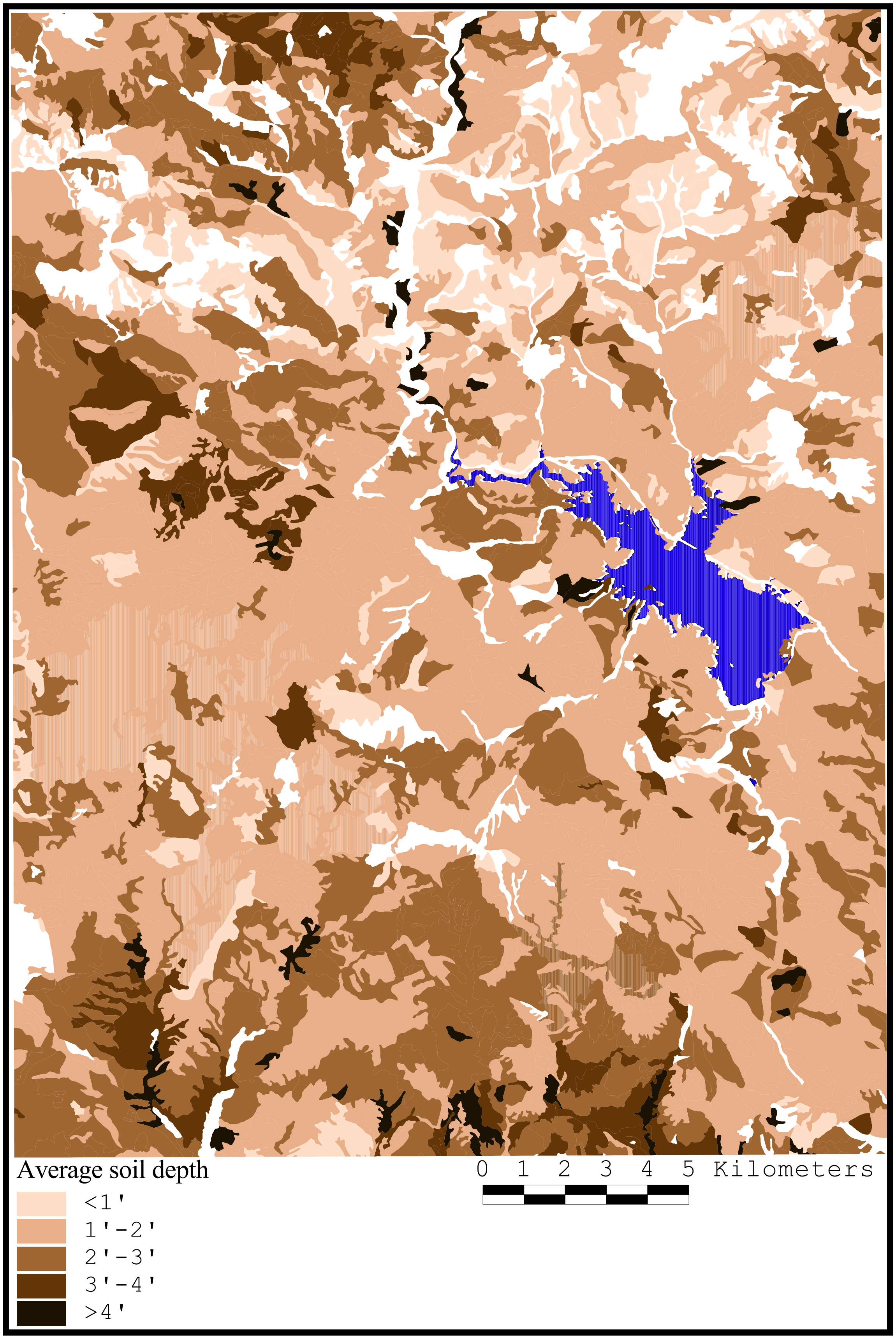


Figure 5. Forest stand types, Whiskeytown National Recreation Area.

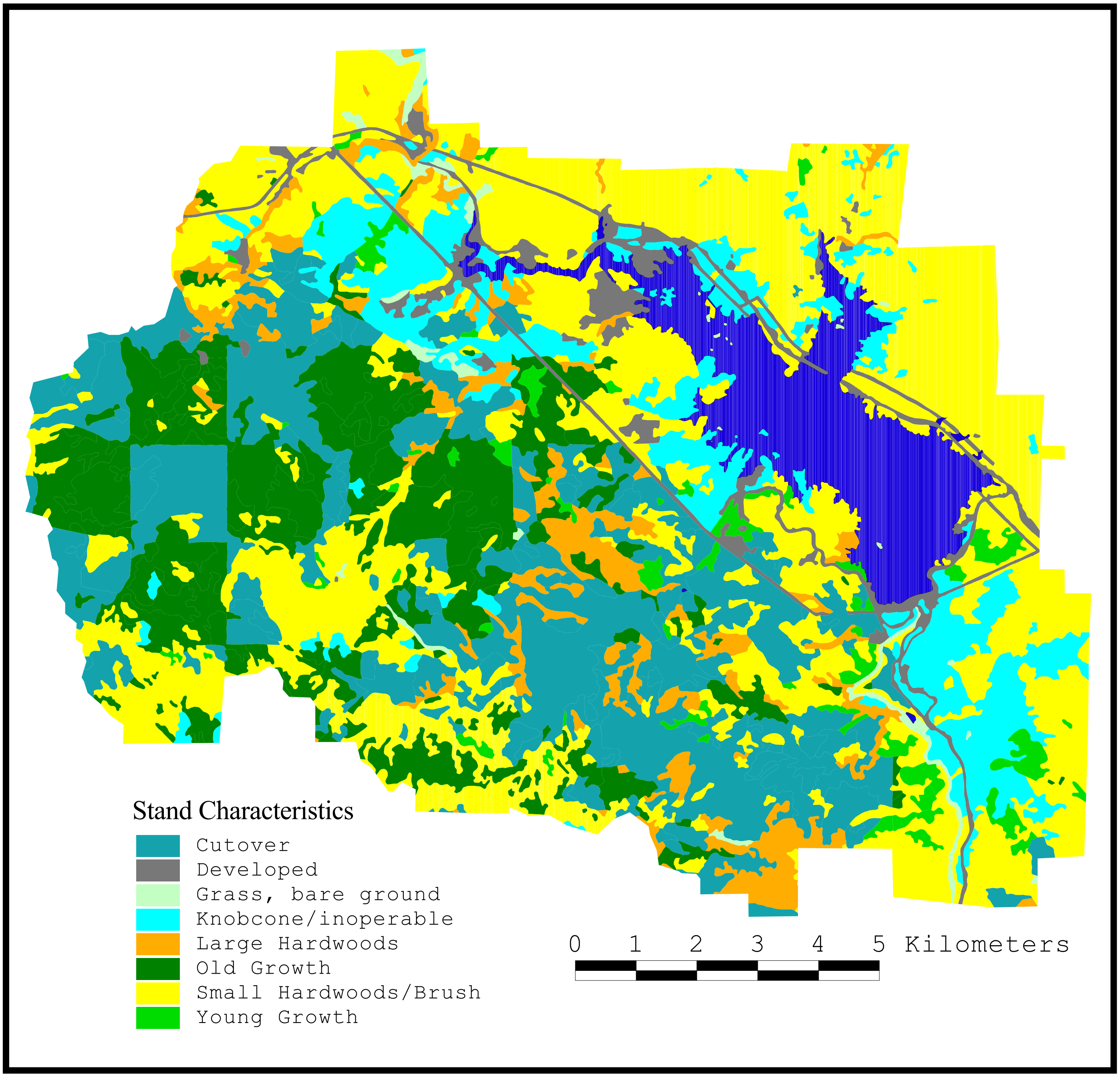


Figure 6. Forest stand composition, Whiskeytown National Recreation Area.

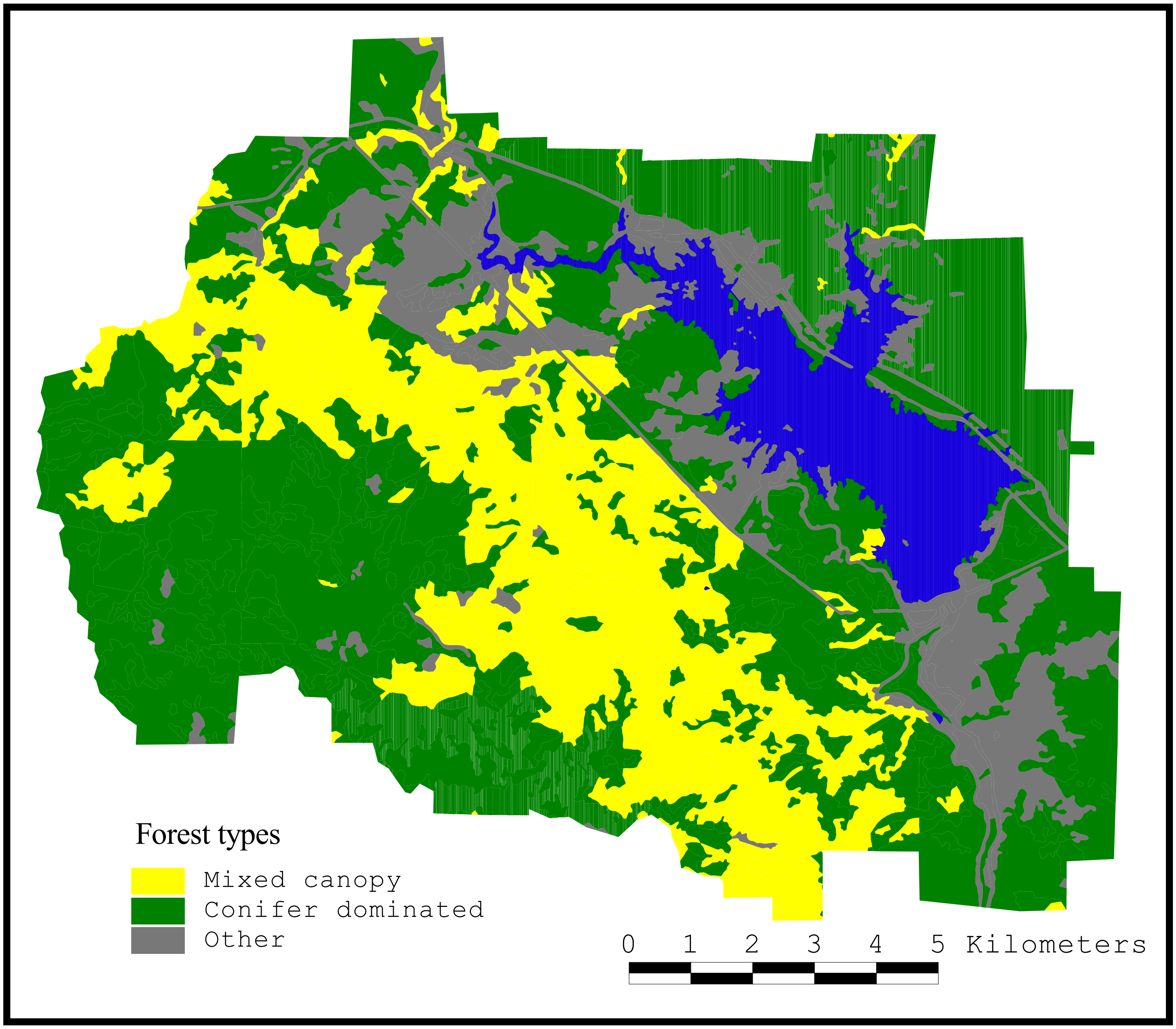


Figure 7. Surface rock and stone filled soils, Whiskeytown National Recreation Area.

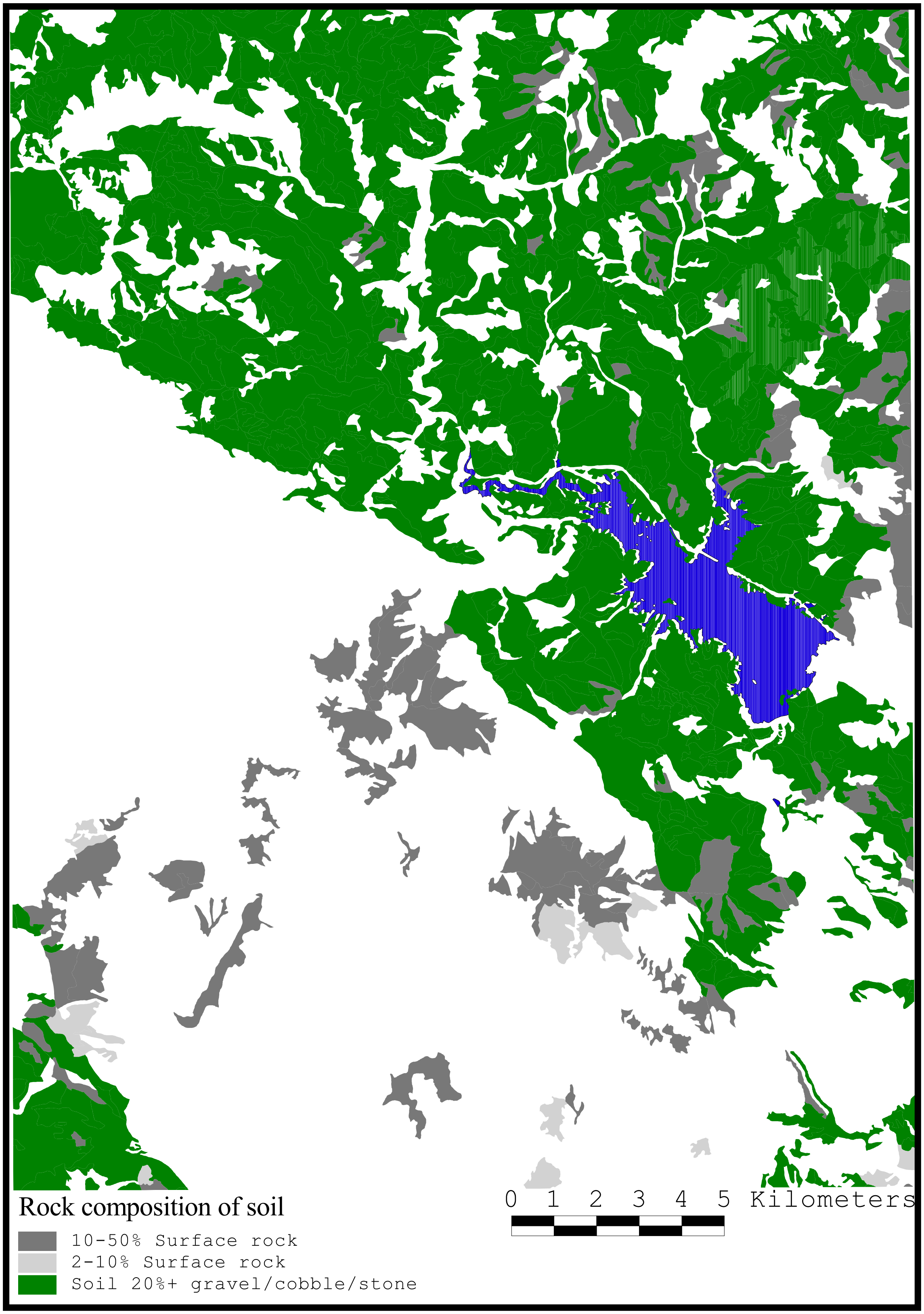


Figure 8. US Forest Service site classifications for Whiskeytown National Recreation Area.

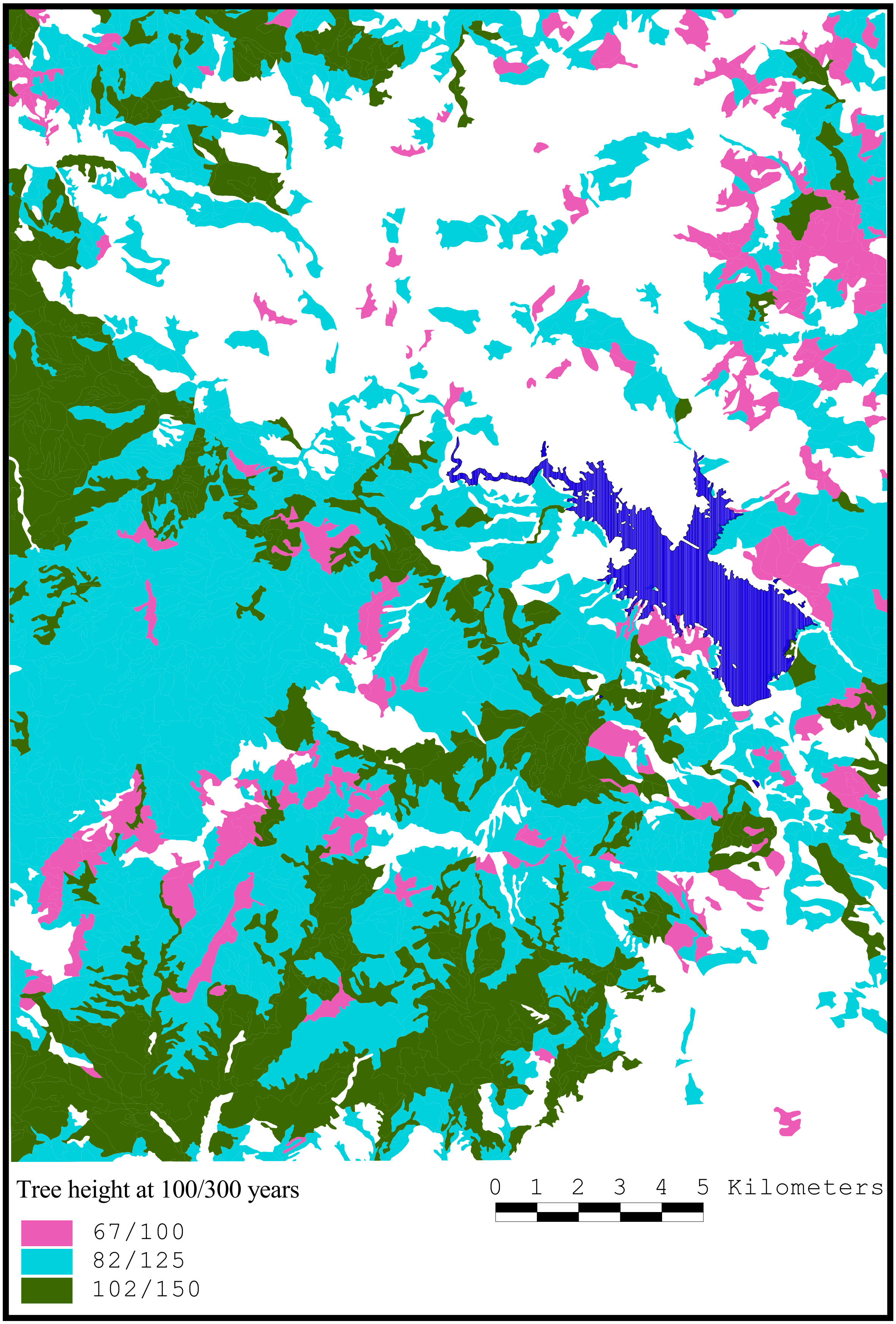


Figure 9. Forest stand tree classifications, Plumas National Forest.

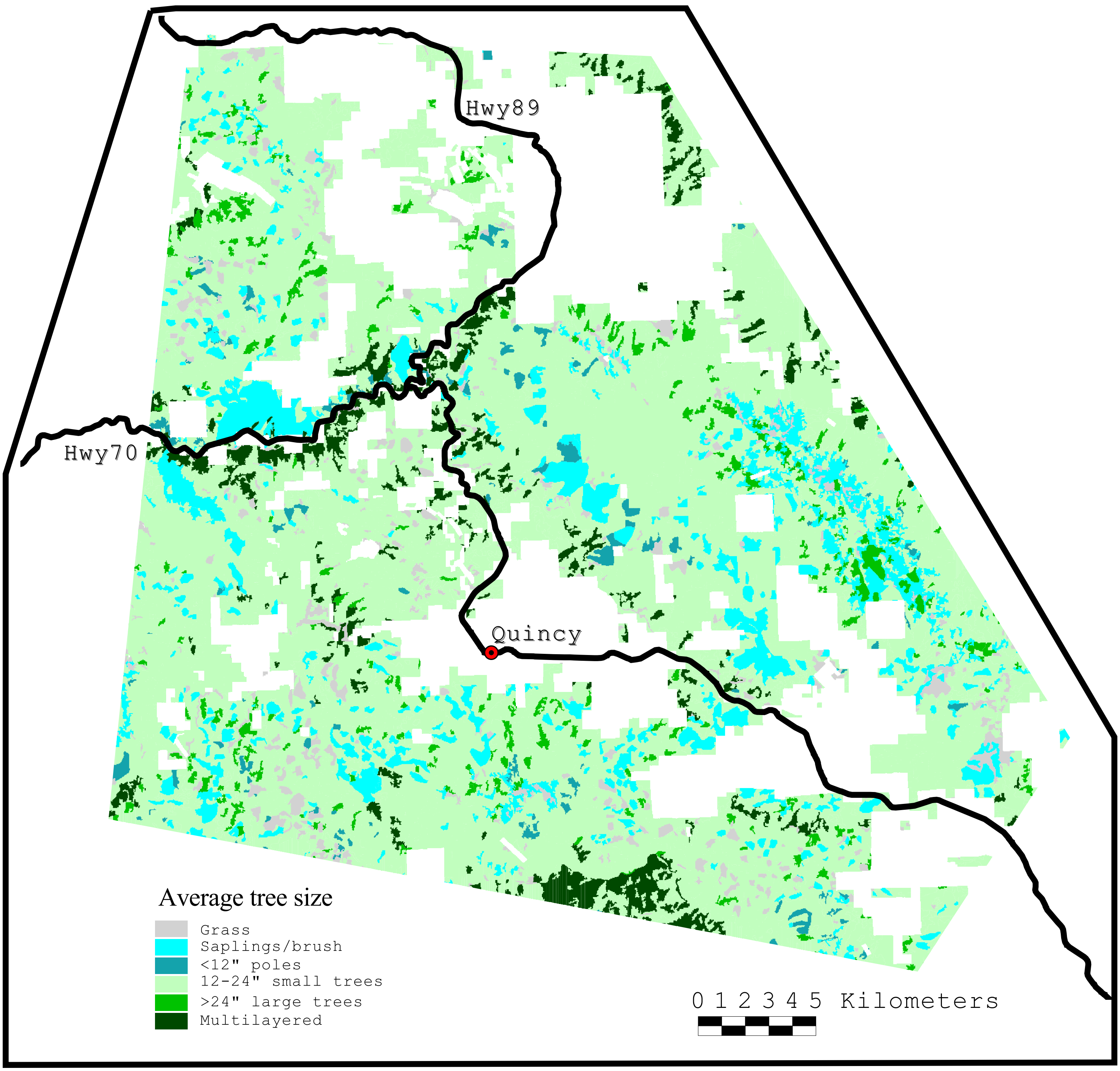


Figure 10. Canopy coverage, Plumas National Forest.

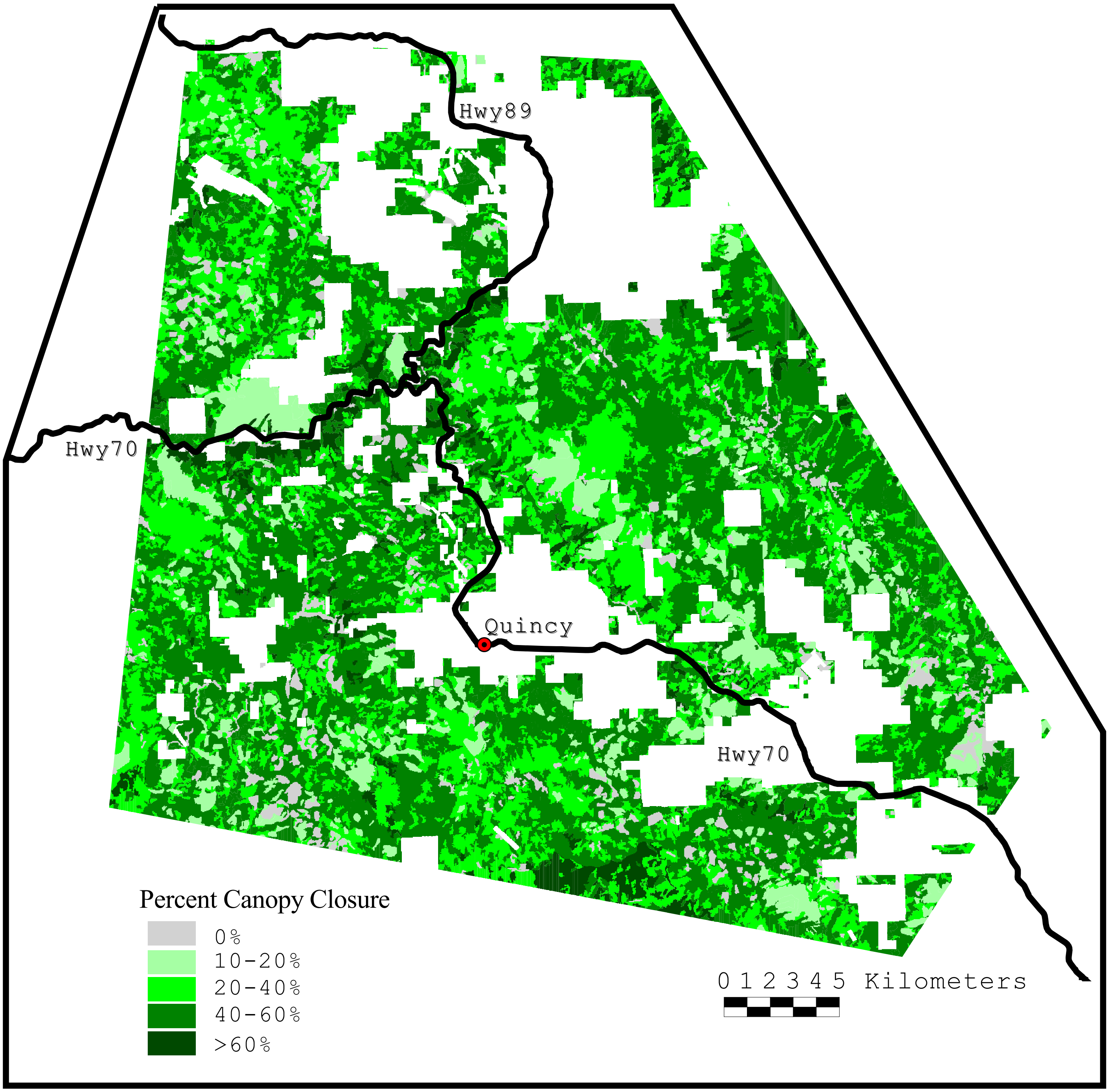
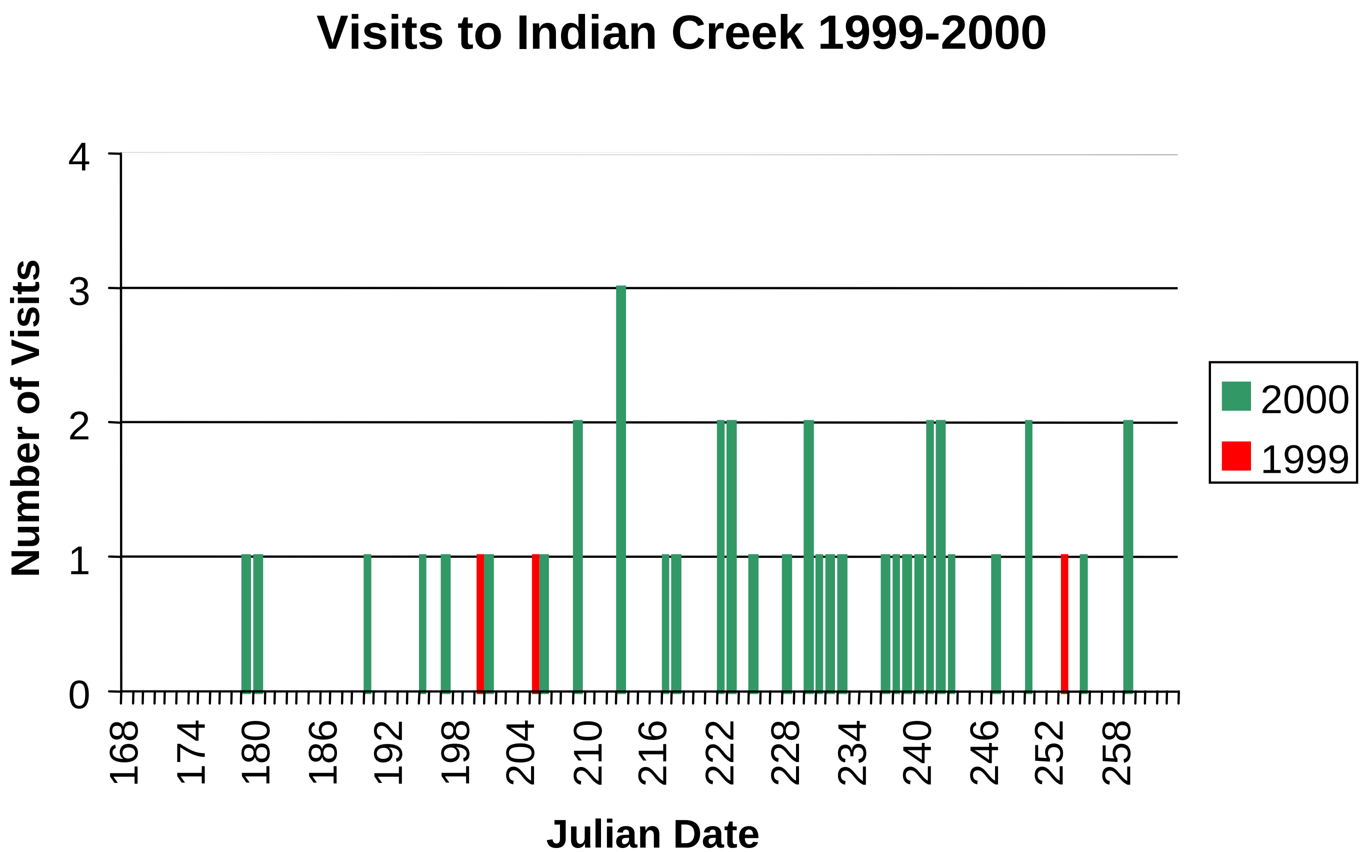


Figure 11. Visits to mineral sites by radio-marked band-tailed pigeons, Plumas National Forest.



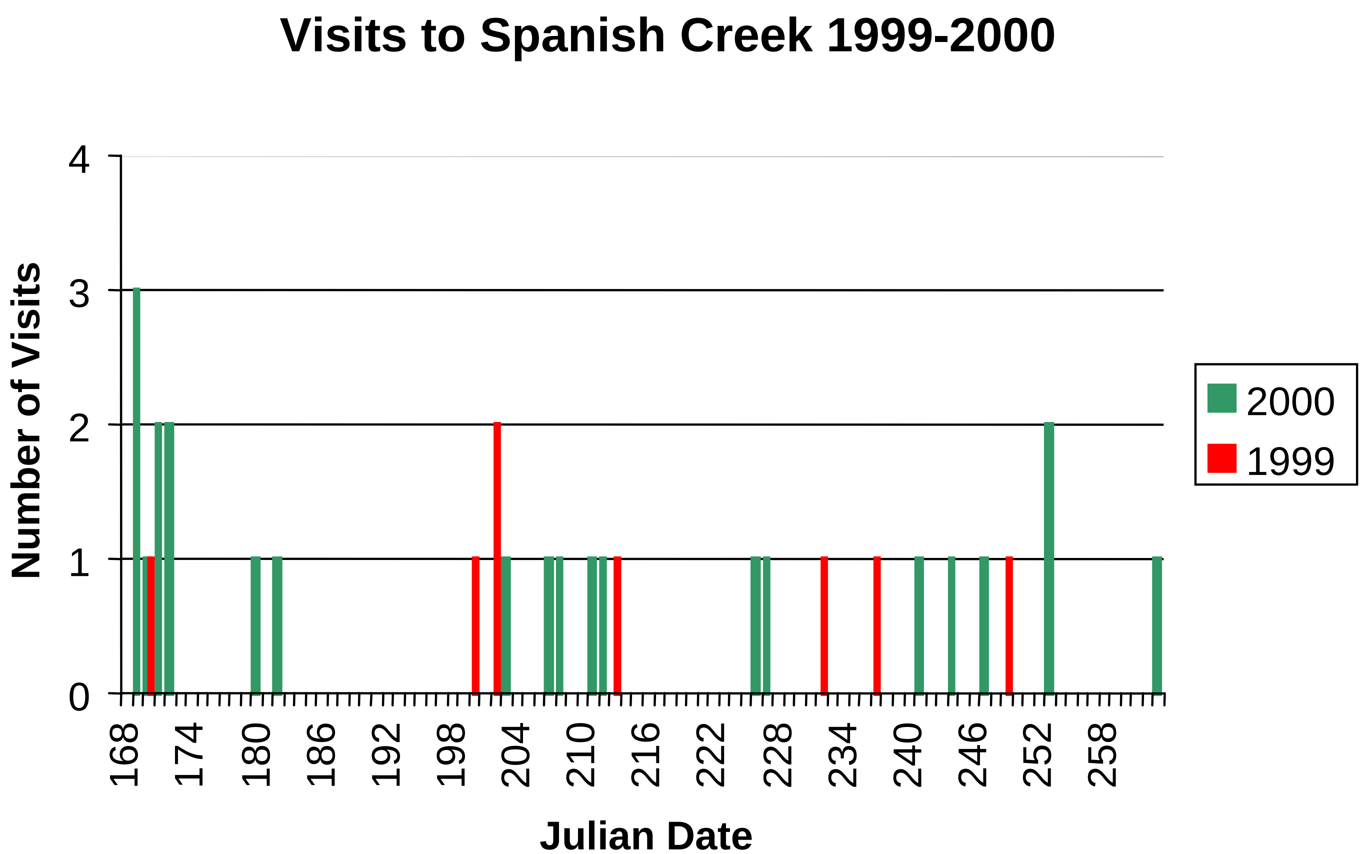
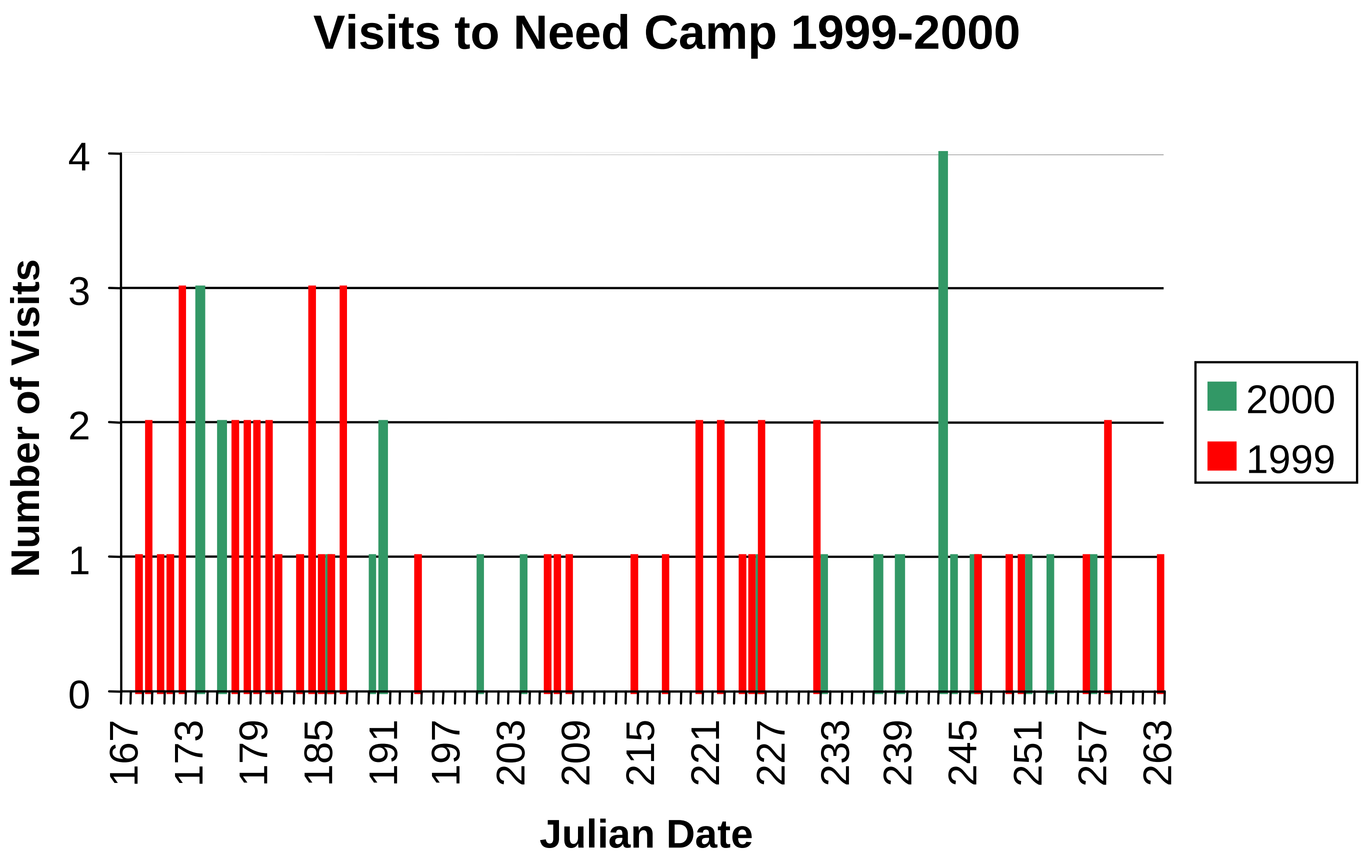


Figure 12. Visits to mineral sites by radio-marked band-tailed pigeons, Whiskeytown National Recreation Area



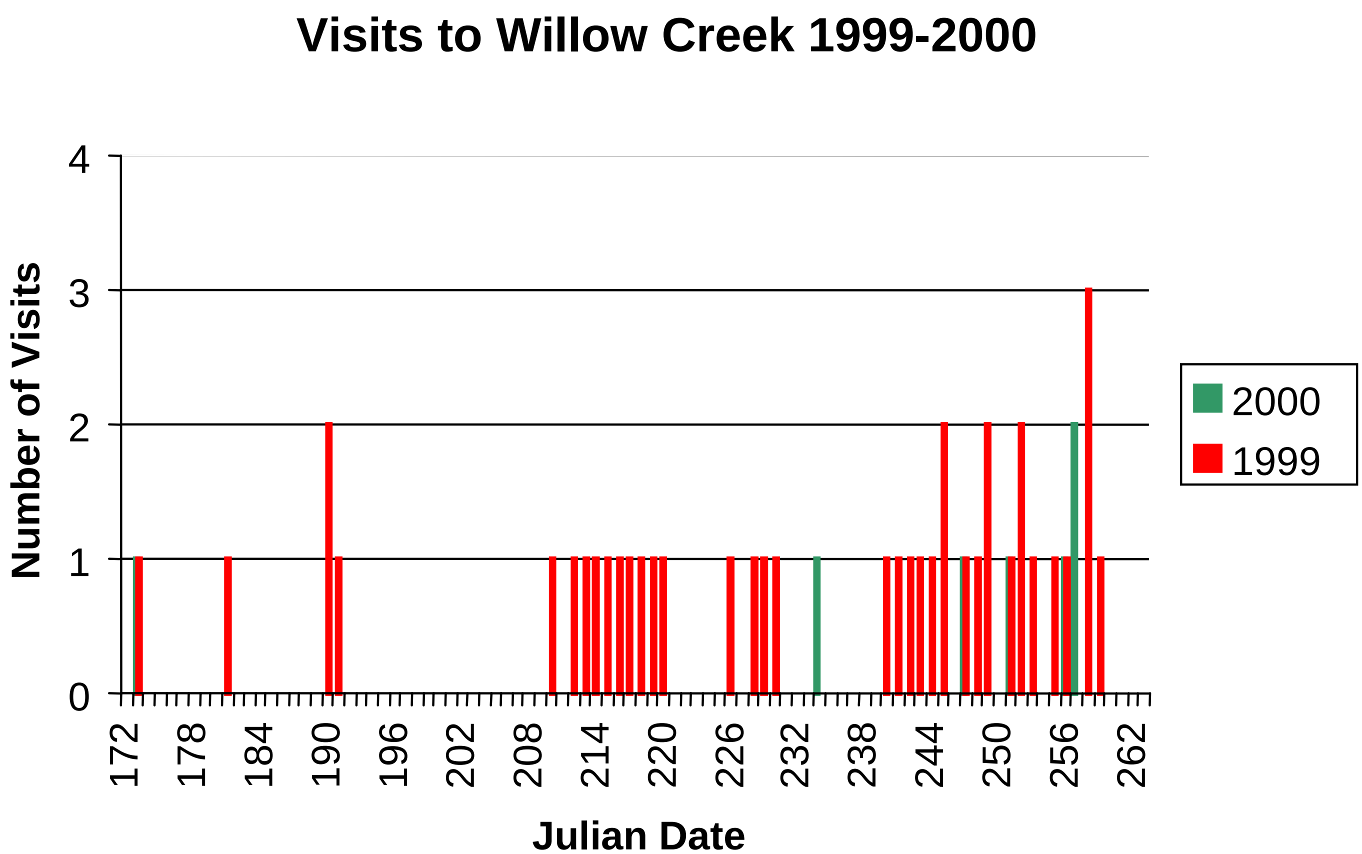
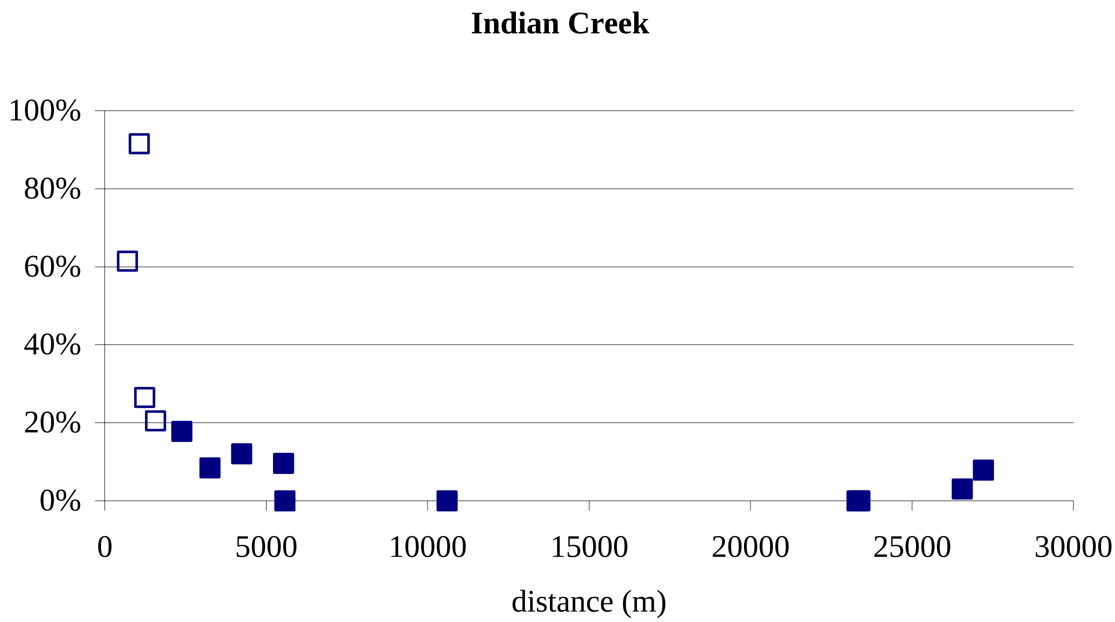


Figure 13. Proportion of days individual band-tailed pigeons attended Indian Creek and Spanish Creek springs plotted against distance from 50% kernel home range centroid. Open squares represent birds having nests near data loggers at the spring.



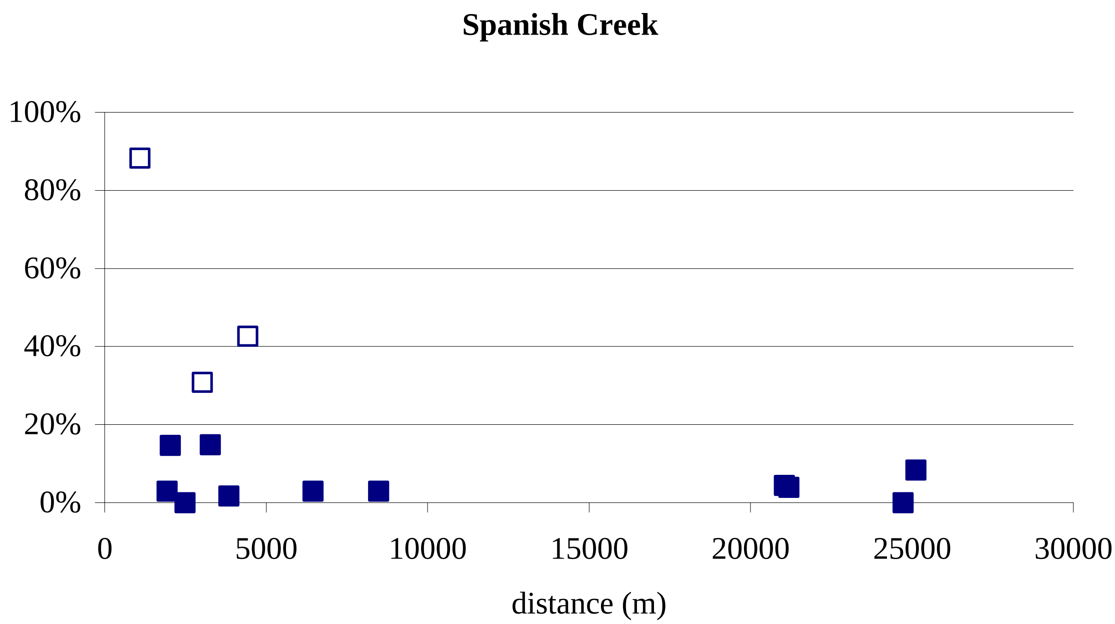


Figure 14. Telemetry locations for radio-marked band-tailed pigeons at the Redding study site.

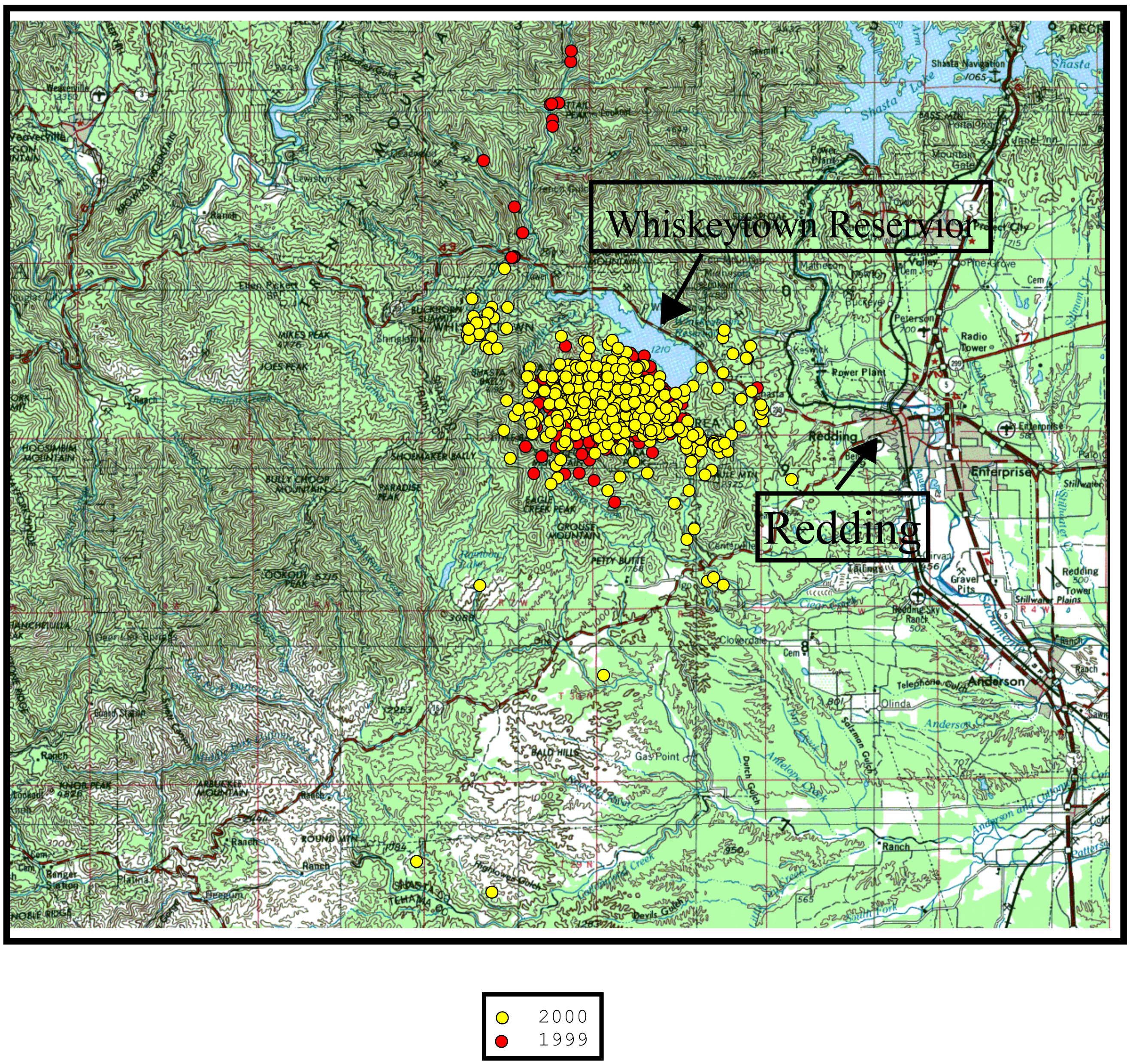


Figure 15. Telemetry locations for radio-marked band-tailed pigeons at the Quincy study site.

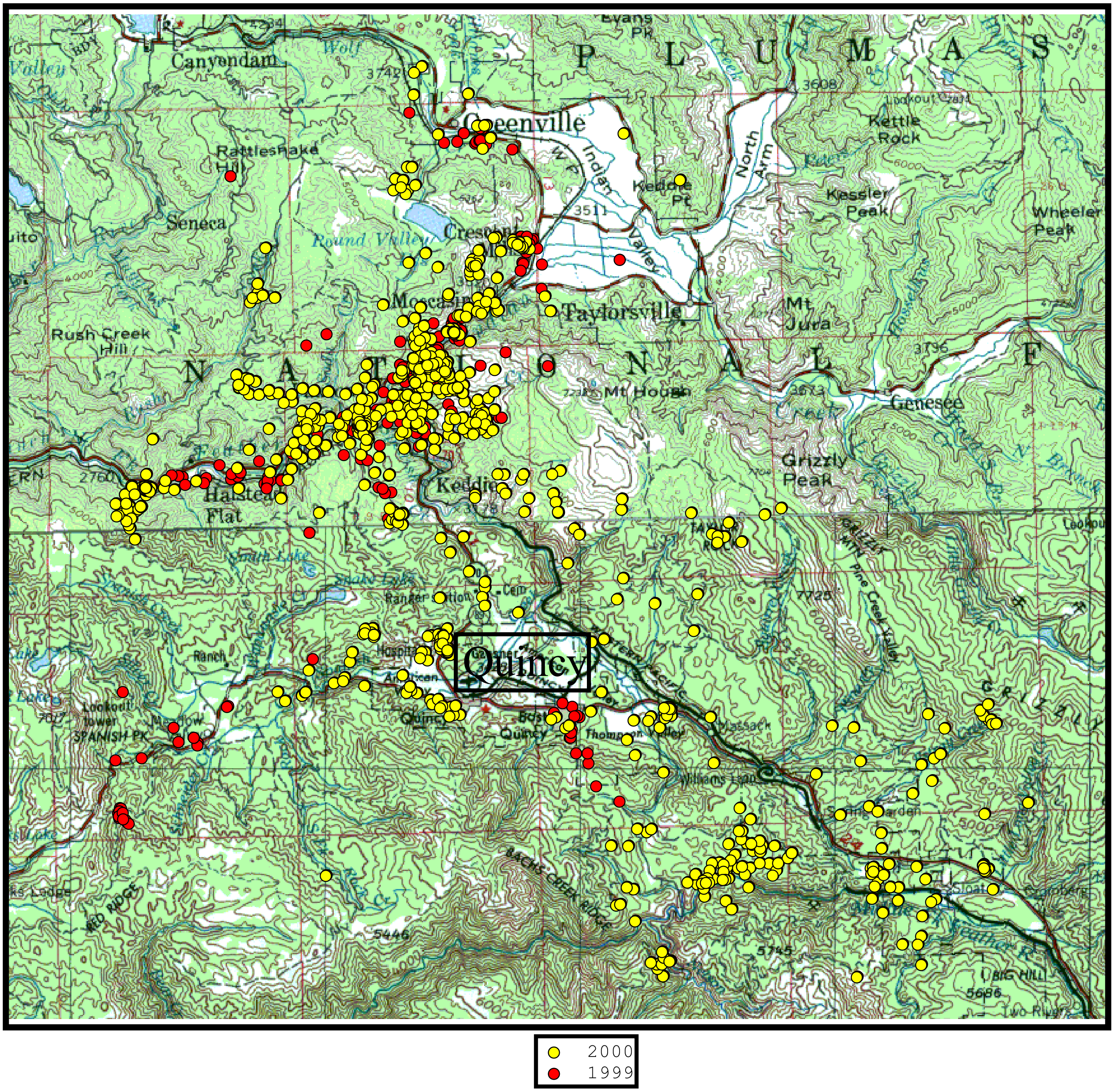


Figure 16. Known mineral springs used by band-tailed pigeons in the Pacific Northwest.

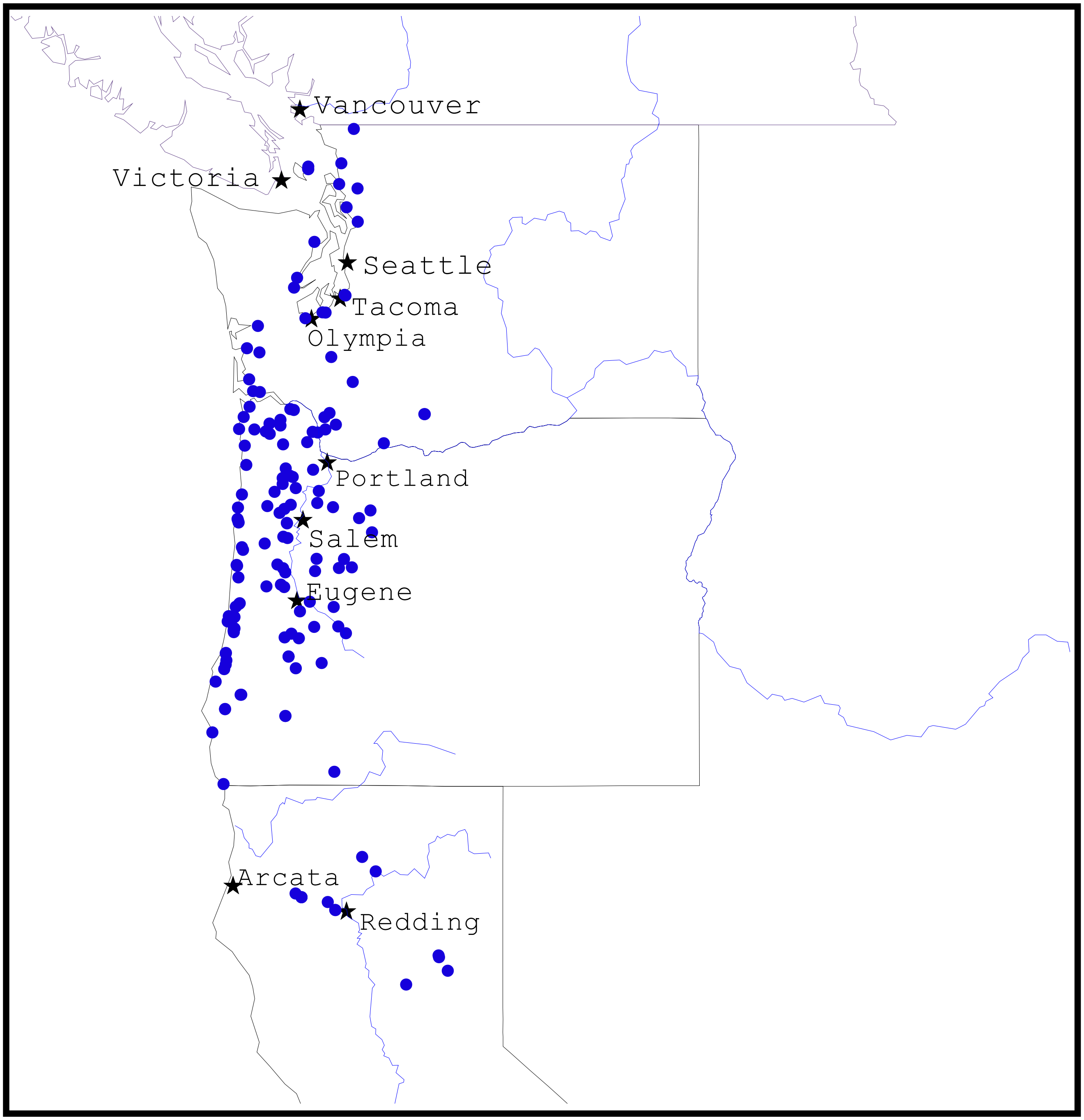
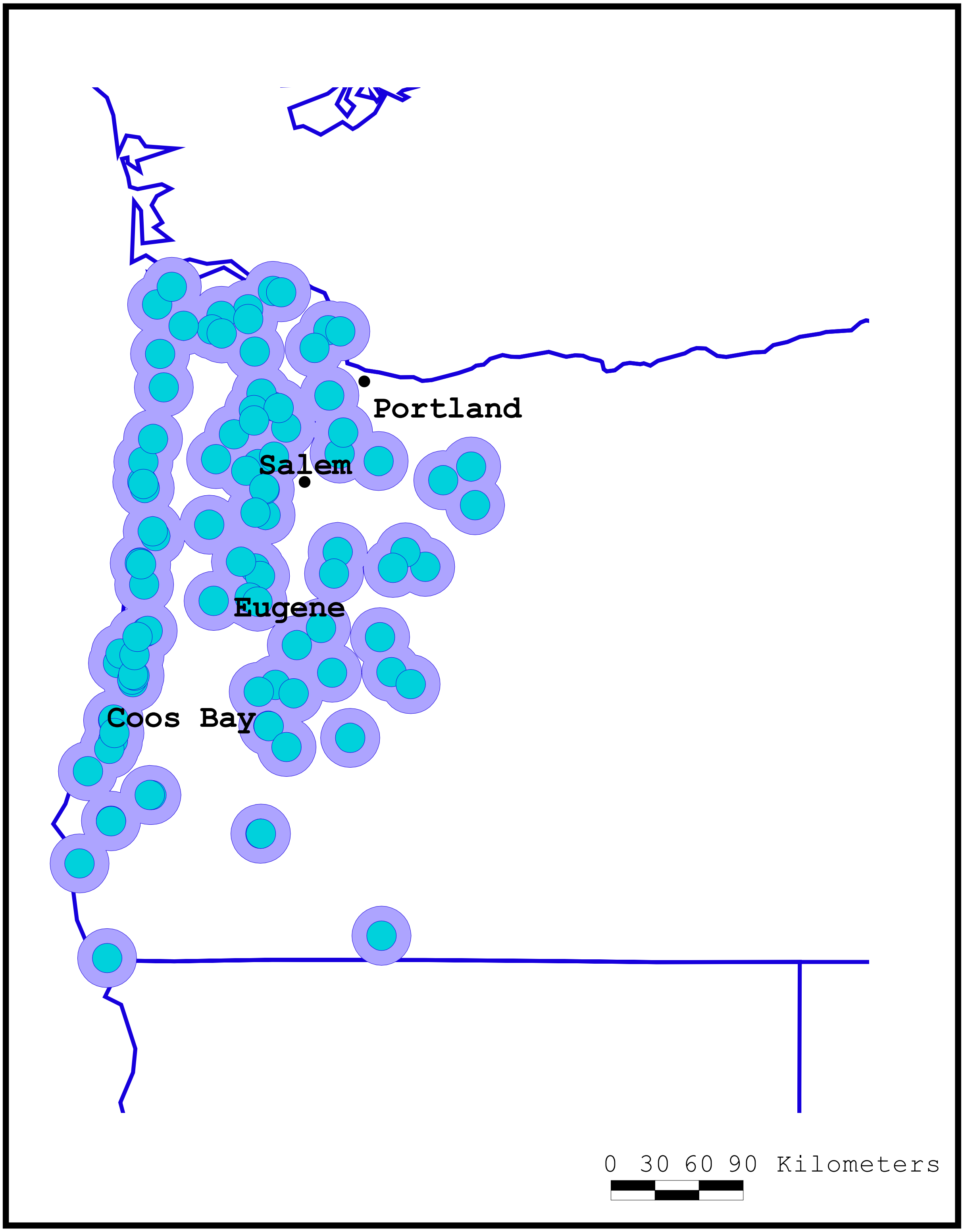


Figure 17. Known current and historical mineral sites used by band-tailed pigeons in Oregon. With buffers of 10 and 20 kilometers.



Appendix A. Spring composition.

Spring Name	Calcium (ppm)	Potassium (ppm)	Sodium (ppm)	Sulphur (%)	Barium (ppm)
Belly Acres	44	*	590	*	0.06
Big Bend	36	6.5	210	0.09	0.015
Need Camp - east	2300	35	7400	*	0.45
Need Camp-west	1400	13	3100	*	0.86
Pigeon Point	1000	34	3700	0.05	1.9
Sky Ranch	540	12	2200	*	0.31
Average	886.667	20.1	2866.667	0.07	0.599

* - below detection limit.

Appendix B. Nest site data collection.

Band Tailed Pigeon Nest Survey - 2000

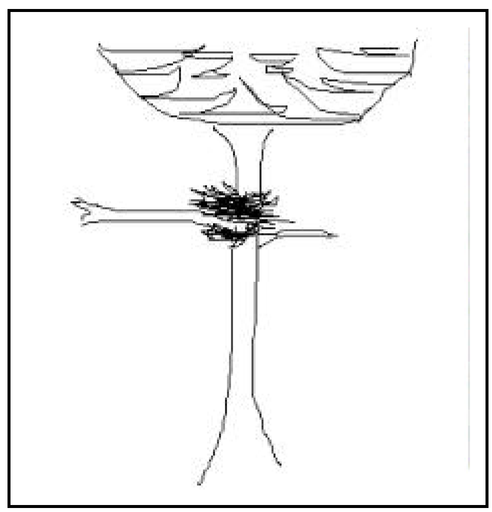
Date Nest Found: 08/08/2000 **Frequency:** 164.233 **Band Number:** ____________
Sex: M **Nest Utm:** E 533034 N 4494137 **Elevation:** ________ m
Nesting Attempt: 1 **Nearest Mineral Spring:** Need Camp **Distance to Spring:** 6620 m

Habitat Modifier: 3 **Habitat Type:** 2 **Slope Aspect:** E **Slope:** 45 E **Nest**
Tree Species: Tan Oak **Tree Height:** 11 m **Crown Base Height:** 8 m
Circ. of Trunk: ________ m **Di. of Crown:** 3 m **Di. of Nest Support Branch:** 5 cm
Length support branch: 3 m **Canopy Cover:** 75 % **Seral condition:** 4

Species composition of nest area (12m radius)
(Primary) Tan Oak % of total available 70
(Secondary) Douglas-fir % of total available 20
(Tertiary) Canyon Live Oak % of total available 5
(Quaternary) Big Leaf Maple % of total available 5
Nest Height: 8 m **Distance from Main Trunk:** 0 m **Distance to Canopy:** 0 m
Canopy Position: 3 **Nest Aspect:** E **Nest Width:** 25 cm **Nest Depth:** ______ cm
Nest visibility: N 2 S 2 E 2 W 2 T 3 B 2
Nest composition & arrangement messy, leaves and twigs, elongated

Date	**Time**	**Parent Status**	**Nest Status**
08/08	13:20	8	O
08/24	12:50	2	O

Nest Physiography Sketches



Nest Fate: _______ **Nest Fate Date:** _________

Additional Notes: Nest is bushy and large- similar to squirrel nest? 8/24 Male/Female or fledgling in vicinity - not on nest ~75 meters away

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 07/20/2000 **Frequency:** 164.112 **Band Number:** 995-21553
Sex: F **Nest Utm:** E 534456 N 4493777 **Elevation:** ____ m
Nesting Attempt: 1 **Nearest Mineral Spring:** Need Camp **Distance to Spring:** 5160 m

Habitat Modifier: 3 **Habitat Type:** 2 **Slope Aspect:** N **Slope:** 45 E
Nest Tree Species: Tan Oak **Tree Height:** 8 m **Crown Base Height:** 0 m
Circ. of Trunk: 0.1 m **Di. of Crown:** 0 m **Di. of Nest Support Branch:** 5 cm
Length support branch: 3 m **Canopy Cover:** 80 % **Seral condition:** 4

Species composition of nest area (12m radius)
(Primary) Tan Oak % of total available 60
(Secondary) Douglas-fir % of total available 15
(Tertiary) Canyon Live Oak % of total available 25
(Quaternary) ____ % of total available ____

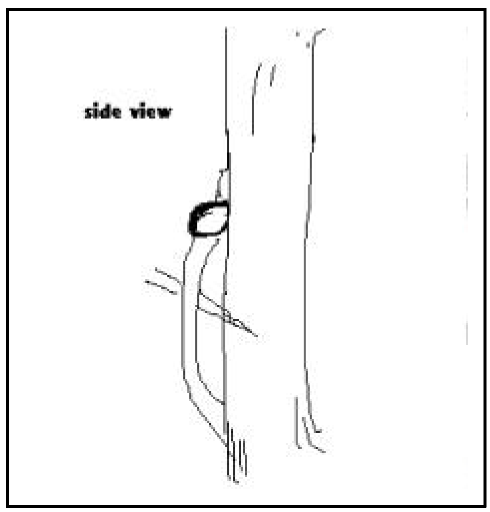
Nest Height: 5 m **Distance from Main Trunk:** 0 m **Distance to Canopy:** 0 m
Canopy Position: 4 **Nest Aspect:** N **Nest Width:** 20 cm **Nest Depth:** 2 cm

Nest visibility: N 1 S 1 E 1 W 1 T 1 B 1

Nest composition & arrangement very simple (branch blocked view of egg)

Date	Time	Parent Status	Nest Status
07/20	13:45	7	E
07/25	14:00	7	E
08/01	07:50	8	E
08/04	12:30	7	N
08/13	09:15	3	N
08/21	16:15	3	N/F
08/24	13:30	3	F

Nest Physiography Sketches



Nest Fate: 2 **Nest Fate Date:** 08/24

Additional Notes: Brady Creek (area) Nest is on a very small oak (no leaves) which is right next to a Douglas-fir. Small tree looks like a branch coming from the Douglas-fir

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 08/16/2000 **Frequency:** 164.202 **Band Number:** ______
Sex: F **Nest Utm:** E 541250 N 4491410 **Elevation:** 450 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Need Camp **Distance to Spring:** 1810 m

Habitat Modifier: 3 **Habitat Type:** 2 **Slope Aspect:** N **Slope:** 45 E
Nest Tree Species: Canyon Live Oak **Tree Height:** 15 m **Crown Base Height:** 12 m
Circ. of Trunk: 0.6 m **Di. of Crown:** ______ m **Di. of Nest Support Branch:** ______ cm
Length support branch: 0.37 m **Canopy Cover:** 60 % **Seral condition:** 4

Species composition of nest area (12m radius)
(Primary) Canyon Live Oak % of total available 70
(Secondary) Ponderosa Pine % of total available 20
(Tertiary) Toyon % of total available 5
(Quaternary) Poison Oak % of total available 5

Nest Height: 10 m **Distance from Main Trunk:** ______ m **Distance to Canopy:** ______ m
Canopy Position: ______ **Nest Aspect:** ______ **Nest Width:** ______ cm **Nest Depth:** ______ cm
Nest visibility: N 1 S 1 E 1 W 1 T 2 B 1

Nest composition & arrangement looks messy - lots of twigs and leaves (similar to 164.233's)

Date	**Time**	**Parent Status**	**Nest Status**
08/16	09:30	5	O

Nest Physiography Sketches

Nest Fate: ______ **Nest Fate Date:** ______

Additional Notes: Bird flushed from 1 of four trees - signal changed direction and disappeared - male bird also present - stayed nearby while we searched and found nest. Originally an 5 location bird. 5 Location was 54126 449139

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 07/07/2000 **Frequency:** 164.423 **Band Number:** ____________
Sex: M **Nest Utm:** E 674066 N 4435766 **Elevation:** 961 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Indian Creek **Distance to Spring:** 975 m

Habitat Modifier: 3 **Habitat Type:** 3 **Slope Aspect:** W **Slope:** 17 E
Nest Tree Species: Canyon Live Oak **Tree Height:** 13.3 m **Crown Base Height:** 8.5 m
Circ. of Trunk: 0.6 m **Di. of Crown:** 3 m **Di. of Nest Support Branch:** 7.5 cm
Length support branch: 2 m **Canopy Cover:** 80 % **Seral condition:** 3

Species composition of nest area (12m radius)
(Primary) Canyon Live Oak % of total available 80
(Secondary) Douglas-fir % of total available 10
(Tertiary) Big Leaf Maple % of total available 10
(Quaternary)____________ % of total available ____________

Nest Height: 7.4 m **Distance from Main Trunk:** 0.5 m **Distance to Canopy:** 1 m
Canopy Position: 3 **Nest Aspect:** 245 E **Nest Width:** 30 cm **Nest Depth:** ~6 cm

Nest visibility: N 2 S 2 E 4 W 2 T 4 B 1

Nest composition & arrangement small branches and oak leaves, elaborate

Date	Time	Parent Status	Nest Status
07/07	13:00	8	U
07/14	12:45	1	U/F?
07/21	10:00	8	U
07/30	09:00	1	U
08/12	13:00	1	U

Nest Physiography Sketches

Nest Fate: 2 **Nest Fate Date:** 07/16/2000

Additional Notes: (note 7/30) In nest was an old canyon live oak leave that I originally thought was an egg, 15 minutes prior to arrival at nest I saw 1 adult male bird and a bird of unknown age/sex fly approximately 100m upstream of nest.
Poison Oak (and leaf litter) only ground cover.

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 08/08/2000 **Frequency:** 164.353 **Band Number:** ____________
Sex: M **Nest Utm:** E 671996 N 4425169 **Elevation:** 1310 m
Nesting Attempt: 2 **Nearest Mineral Spring:** Spanish Creek **Distance to Spring:** 8340m

Habitat Modifier: 4 **Habitat Type:** 1 **Slope Aspect:** S **Slope:** 2 E
Nest Tree Species: Douglas-fir **Tree Height:** 12 m **Crown Base Height:** 2 m
Circ. of Trunk: 1.015 m **Di. of Crown:** 3.5 m **Di. of Nest Support Branch:** 5 cm
Length support branch: 2 m **Canopy Cover:** 80 % **Seral condition:** 2

Species composition of nest area (12m radius)
(Primary) Douglas-fir % of total available 95
(Secondary) Rose sp. (shrub) % of total available 5
(Tertiary)____________ % of total available ____________
(Quaternary)____________ % of total available ____________

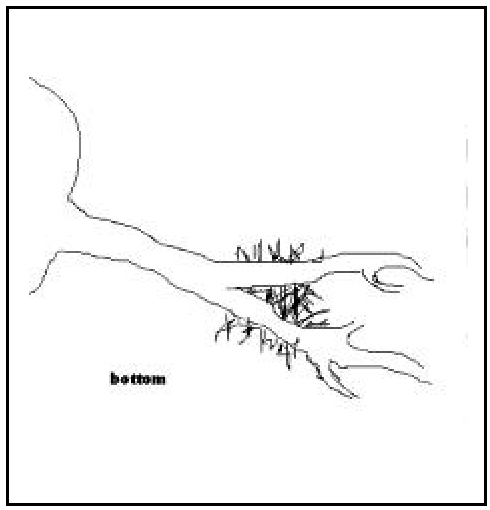
Nest Height: 5.7 m **Distance from Main Trunk:** 1.0 m **Distance to Canopy:** 0 m
Canopy Position: 2 **Nest Aspect:** 145 E **Nest Width:** 25 cm **Nest Depth:** 1 cm

Nest visibility: N 4 S 4 E 3 W 3 T 4 B 4

Nest composition & arrangement green doug-fir limbs (&needles) in crotch of branch (2 support limbs)

Date	**Time**	**Parent Status**	**Nest Status**
08/08	17:00	8	E
08/18	16:30	7	E
08/24	15:45	1	N
09/04	18:30	1	F
09/11	09:15	1	U

Nest Physiography Sketches



Nest Fate: 2 **Nest Fate Date:** 09/04/2000

Additional Notes: ____

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 08/16/2000 **Frequency:** 164.262 **Band Number:** ____________
Sex: F **Nest Utm:** E 666680 N 4437978 **Elevation:** 1370 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Indian Creek **Distance to Spring:** 6450m

Habitat Modifier: 2 **Habitat Type:** 1 **Slope Aspect:** S **Slope:** 24 E
Nest Tree Species: Douglas-fir **Tree Height:** 10 m **Crown Base Height:** 0.5 m
Circ. of Trunk: 1.1 m **Di. of Crown:** 5 m **Di. of Nest Support Branch:** 4 cm
Length support branch: 2.25 m **Canopy Cover:** 75 % **Seral condition:** 2

Species composition of nest area (12m radius)
(Primary) Douglas-fir % of total available 50
(Secondary) Incense cedar % of total available 35
(Tertiary) Ponderosa Pine % of total available 15
(Quaternary)____________ % of total available ____________

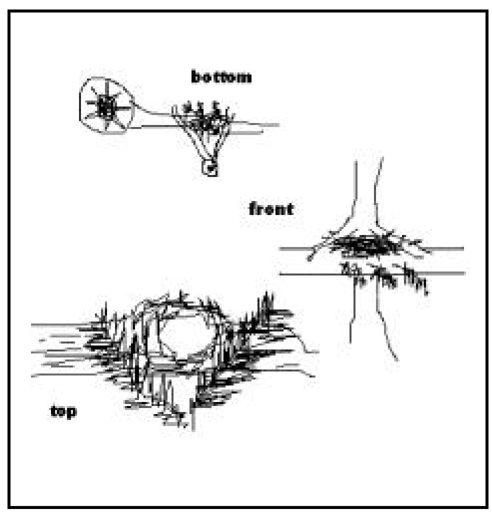
Nest Height: 3 m **Distance from Main Trunk:** 1.0 m **Distance to Canopy:** 2 m
Canopy Position: 2 **Nest Aspect:** 225 E **Nest Width:** 20 cm **Nest Depth:** 3 cm

Nest visibility: N 2 S 2 E 4 W 2 T 4 B 3

Nest composition & arrangement Doug-fir needles and branches for material, single support branch with lateral support from 2nd doug-fir.

Date	**Time**	**Parent Status**	**Nest Status**
08/16	09:00	7	E
08/28	12:30	8	E
08/31	08:35	7	N
09/11	14:00	1	N
09/20	14:15	1	U

Nest Physiography Sketches



Nest Fate: 7 **Nest Fate Date:** 09/13/2000

Additional Notes: 8/31-nestling recently hatched can not be more than 48 hours old
9/13-bird quit returning to nest at night (fledge?)

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 07/27/2000 **Frequency:** 164.214 **Band Number:** ____________
Sex: M **Nest Utm:** E 686816 N 4416960 **Elevation:** 1430 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Fells Flat **Distance to Spring:** 1600m

Habitat Modifier: 1 **Habitat Type:** 3 **Slope Aspect:** S **Slope:** 18.5 E
Nest Tree Species: Douglas-fir **Tree Height:** 27.6 m **Crown Base Height:** 8 m
Circ. of Trunk: 1.13 m **Di. of Crown:** 10 m **Di. of Nest Support Branch:** 10 cm
Length support branch: 4.5 m **Canopy Cover:** 90 % **Seral condition:** 2

Species composition of nest area (12m radius)
(Primary) Douglas-fir % of total available 75
(Secondary) California Black Oak % of total available 15
(Tertiary) Ponderosa Pine % of total available 10
(Quaternary) Manzanita % of total available 1

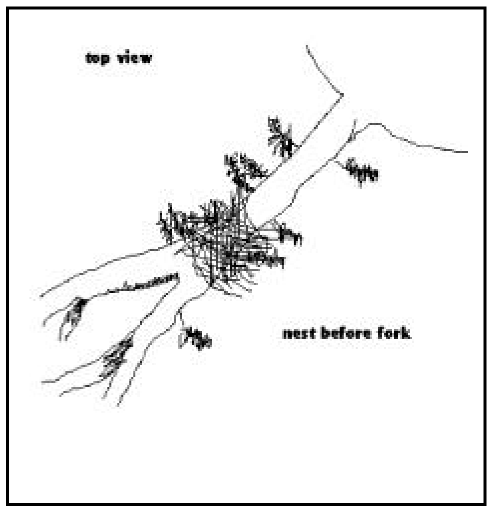
Nest Height: 6.6 m **Distance from Main Trunk:** 1.75 m **Distance to Canopy:** 1.5 m
Canopy Position: 4 **Nest Aspect:** 140 E **Nest Width:** 60 cm **Nest Depth:** 10 cm

Nest visibility: N 4 S 3 E 4 W 4 T 4 B 2

Nest composition & arrangement lowest branches of the tallest tree, Doug-fir needles and twigs, elaborate.

Date	Time	Parent Status	Nest Status
07/27	11:20	8	U
08/03	11:45	7	U
08/11	08:30	8	E
08/17	10:30	1	E
08/29	11:30	1	D

Nest Physiography Sketches



Nest Fate: 6? **Nest Fate Date:** 08/18/2000

Additional Notes: 8/3 Female doing “broken wing” as I approach. 8/29 - half-dozen feather under nest, possibly missing twigs from nest structure. Egg not visible must potentially still in nest.
In tree farm, dense growth. nest tree is one of three with common root stock.

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 08/25/2000 **Frequency:** 164.063 **Band Number:** ____________
Sex: F **Nest Utm:** E 673638 N 4435068 **Elevation:** 1015 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Indian Creek **Distance to Spring:** 675m

Habitat Modifier: 3 **Habitat Type:** 3 **Slope Aspect:** N **Slope:** 54 E
Nest Tree Species: Canyon Live Oak **Tree Height:** 6.5 m **Crown Base Height:** 1 m
Circ. of Trunk: 0.51 m **Di. of Crown:** 3.5 m **Di. of Nest Support Branch:** 4 cm
Length support branch: 1.5 m **Canopy Cover:** 60 % **Seral condition:** 2

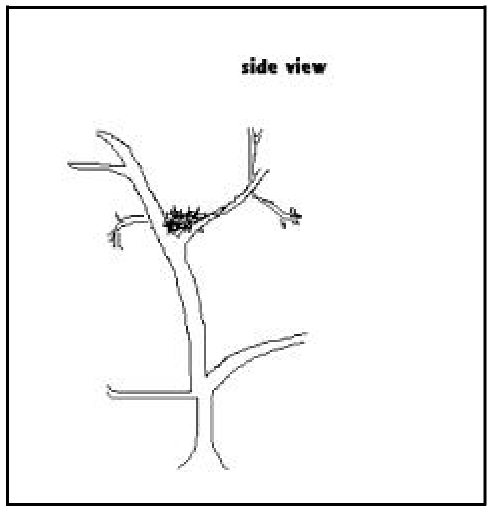
Species composition of nest area (12m radius)
(Primary) Douglas-fir % of total available 90
(Secondary) Canyon Live Oak % of total available 8
(Tertiary) Pacific Dogwood % of total available 1
(Quaternary) California Black Oak % of total available 1

Nest Height: 6 m **Distance from Main Trunk:** 0.01 m **Distance to Canopy:** 2 m
Canopy Position: 1 **Nest Aspect:** 35 E **Nest Width:** 25 cm **Nest Depth:** 5 cm
Nest visibility: N 4 S 2 E 3 W 1 T 4 B 2

Nest composition & arrangement top fork of main trunk, dead branches (fir) primary material

Date	**Time**	**Parent Status**	**Nest Status**
08/25	09:00	7	C
08/31	10:00	3	E
09/11	11:10	5	E
09/15	13:30	8	N
09/25	13:30	1	N

Nest Physiography Sketches



Nest Fate: 7 **Nest Fate Date:** __________

Additional Notes: 8/25 Could not see in nest, but was not complete. 8/31 Nest now complete, nearly 50% larger than on the 25th. 9/11 feather in bottom of nest, nest to egg. 9/15 hatchling 3-4 days old.

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 07/07/2000 **Frequency:** 164.353 **Band Number:** ____________
Sex: M **Nest Utm:** E 669141 N 4422774 **Elevation:** 1200 m
Nesting Attempt: 1 **Nearest Mineral Spring:** SpanishCreek **Distance to Spring:** 11525m

Habitat Modifier: 1 **Habitat Type:** 1 **Slope Aspect:** E **Slope:** 28 E
Nest Tree Species: Incense Cedar **Tree Height:** 25 m **Crown Base Height:** 6 m
Circ. of Trunk: 1.22 m **Di. of Crown:** 2.5 m **Di. of Nest Support Branch:** 8 cm
Length support branch: 1.5 m **Canopy Cover:** 80 % **Seral condition:** 3/2

Species composition of nest area (12m radius)
(Primary) Douglas-fir % of total available 80
(Secondary) Incense Cedar % of total available 20
(Tertiary)____________ % of total available ________
(Quaternary)____________ % of total available ________

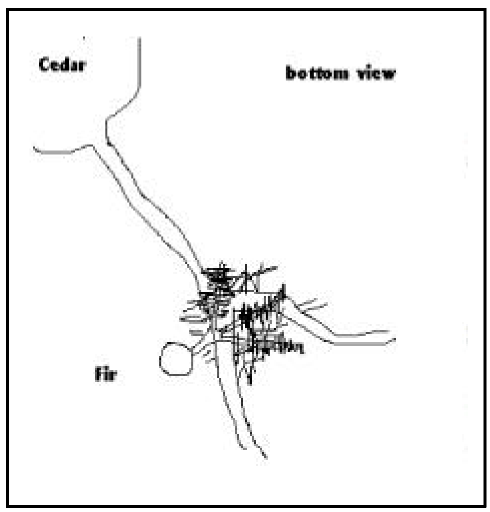
Nest Height: 4 m **Distance from Main Trunk:** 0.5 m **Distance to Canopy:** 2 m
Canopy Position: 4 **Nest Aspect:** 160 E **Nest Width:** 50 cm **Nest Depth:** 8 cm

Nest visibility: N 4 S 1 E 1 W 2 T 4 B 1

Nest composition & arrangement Fir branches in (dead) cedar limb

Date	Time	Parent Status	Nest Status
07/07	10:30	6	U?
07/15	13:30	7	E?
07/18	09:30	1	D
07/21	09:00	1	D

Nest Physiography Sketches



Nest Fate: 4 **Nest Fate Date:** 7/16/2000

Additional Notes: 07/07 - Pile of pigeon feathers 7 meters NW of nest. Both birds at nest, no egg 07/15 - Something inside nest but unsure if it is an egg or just feathers. Female flew off with a poor imitation of a "broken wing" maneuver. 07/18 and 07/21 male heard on nest all week. 20-25 contour feathers around base of nest or caught in spiderwebs between nest and ground. No sign of egg or shell fragments. No other sign of mortality, nest intact.

Appendix B: Continued

Band Tailed Pigeon Nest Survey - 2000

Date Nest Found: 08/04/2000 **Frequency:** 164.252 **Band Number:** ______
Sex: M **Nest Utm:** E 675152 N 4437036 **Elevation:** 1140 m
Nesting Attempt: 1 **Nearest Mineral Spring:** Indian Creek **Distance to Spring:** 2560m

Habitat Modifier: 2 **Habitat Type:** 3 **Slope Aspect:** W **Slope:** 32 E
Nest Tree Species: Canyon Live Oak **Tree Height:** 9.8 m **Crown Base Height:** 1.5 m
Circ. of Trunk: 0.78 m **Di. of Crown:** 3 m **Di. of Nest Support Branch:** 10 cm
Length support branch: 2.25 m **Canopy Cover:** 75 % **Seral condition:** 2

Species composition of nest area (12m radius)
(Primary) Canyon Live Oak % of total available 40
(Secondary) Big Leaf Maple % of total available 10
(Tertiary) Ponderosa Pine % of total available 10
(Quaternary) Doug-fir % of total available 40

Nest Height: 8.8 m **Distance from Main Trunk:** 1.5 m **Distance to Canopy:** 2.5 m
Canopy Position: 1 **Nest Aspect:** 258 E **Nest Width:** 27 cm **Nest Depth:** 2 cm

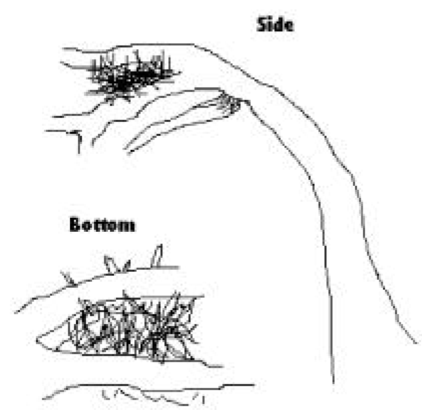
Nest visibility: N 4 S 2 E 2 W 3 T 3 B 4

Nest composition & arrangement Both oak and pin/fir branches/leaves and needles for material

Date	**Time**	**Parent Status**	**Nest Status**
08/04	14:00	8	U?
08/12	12:00	8	N
08/21	11:45	6	N?
08/28	10:30	4	N
08/31	09:00	4	F
09/04	14:00	1	U
09/11	12:30	1	U

Nest Physiography Sketches

Table 10



Nest Fate: 2 **Nest Fate Date:** 09/01/2000

Additional Notes: ______

Appendix B: Continued

Nest Visibility
1= easily visible 0-25%
2 = partially obscured 26-50%
3 = mostly obscured 51-75%
4 = nest not/barely visible 76-100%

Parent Status
1 = both absent
2 = both present
3 = female present
4 = male present
5 = female on nest/male present
6 = male on nest/female present
7 = female on nest/male absent
8 = male on nest/female absent
9 = other/unknown (make note)

Nest Status
C = construction (make note)
U = undisturbed/normal
D = disturbed (make note)
E = egg present
N = nestling present (# 20 days old)
F = fledgling present ($ 20 days old)
O = other/unknown (make note)

Fate
1 = egg hatched
2 = nestling fledged
3 = unsuccessful destroyed (make note)
4 = unsuccessful abandoned (make note)
5 = unsuccessful egg addled
6 = unsuccessful 1 or both parents killed (make note)
7 = other/unknown (make note)

Seral Condition
1 = sapling
2 = small sawtimber
3 = large sawtimber
4 = old growth

Habitat Modifier
1 = coniferous Forest
2 = oak Grassland
3 = mixed conifer/oak
4 = riparian (willows, cottonwoods, berries, etc)
5 = shrub dominated (elder, blackberries, manzanita, etc)

Habitat Type
1 = ridge top
2 = mid-height
3 = canyon bottom
4 = meadow/valley area

Canopy Position
1 = top of canopy
2 = middle of canopy
3 = bottom of canopy
4 = below canopy