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MT. GRAHAM RED SQUIRREL MONITORING PROGRAM

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INTRODUCTION

The University of Arizona's Mount Graham Red Squirrel Monitoring Program continued monitoring the status of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) near the Mount Graham International Observatory (MGIO) in 1996. The MGIO is located along a ridge extending westward from Hawk Peak in the Graham (Pinaleño) Mountains of southeastern Arizona. In 1996, the MGIO site consisted of two operating facilities, the Vatican Advanced Technology Telescope (VATT) and the Sub-Millimeter Telescope (SMT), a maintenance and generator building, and a 3.2 km access road (FR 4556). In June, tree clearing for the LBT was completed and construction (blasting, rock excavation and hauling, and concrete pouring) continued until mid-November.

The Monitoring Program was established in 1989 to meet the requirements of the MGIO Management Plan (USDA Forest Service 1989), with the principal goal of detecting possible effects of construction on the squirrels. Four areas encompassing 340.9 ha were defined in the vicinity of the MGIO site to monitor red squirrel populations (Figure 1). These areas include two forest habitat types: transitional (TR) or mixed conifer forest and spruce-fir (SF) forest. The TR habitat, below 3050 m elevation, is composed of Engelmann spruce (*Picea engelmannii*), corkbark fir (*Abies lasiocarpa* var. *arizonica*), Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), southwestern white pine (*P. strobiformis*) and aspen (*Populus tremuloides*). The SF habitat, above 3050 m elevation, is composed of Engelmann spruce and corkbark fir. In each habitat type, an area within 300 m of the telescope sites and access road was defined as the *construction* area. For comparison, a *non-construction* area beyond 300 m from the MGIO site or the access road was defined in each habitat. This resulted in four monitored areas: TR habitat construction (TRC) (83.0 ha), TR habitat non-construction (TRN) (24.4 ha), SF habitat construction (SFC) (104.6 ha) and SF habitat non-construction (SFN) (128.9 ha).

On 24 April 1996, the Clark Peak fire (CP fire) started on the northwestern end of the Pinaleños and burned along the south and west side of the range before it was contained within an approximately 2718 ha perimeter on 8 May. Much of the monitored areas within the fire perimeter was burned and is no longer considered suitable red squirrel habitat (Figure 2). On the TRC area, 34.5 ha (41%) were intensely burned (all trees and ground cover were destroyed) including 23 red squirrel middens. On the SFC area, 24.9 ha (25%) were intensely burned and ten middens were destroyed. Forty-seven middens had some fire and/or suppression damage within 15 m of the midden center. In addition, seven food resource plots on the TRC area and four on the SFC area were burned.

The CP fire limited access to the mountain in May and interrupted the census schedule. Much time in the months following the CP fire was devoted to assessment of the damage from the CP fire and associated suppression activities. In June, a complete census of all middens was made, including re-locating destroyed middens within the burned area. July and August were spent measuring damage to middens from fire and/or suppression and mapping the fire perimeters within the monitored areas. Complete midden censuses were not conducted in July and August, but several middens near the construction site or access road were checked during other monitoring activities.

A census of all middens within the monitored areas was conducted in February, April, June, September, and December. In addition, middens within 100 m of construction were censused in October. These data were analyzed to determine the potential effects of construction on squirrel numbers, distribution, and density.

Efforts were continued to describe and quantify other environmental parameters that may affect squirrel populations on Mt. Graham. Food resources were measured at 35 sites distributed among the monitored areas (Figure 1). Conifer seeds were collected in April before the CP Fire. Eleven of the 35 food resource plots were destroyed or heavily damaged during the fire. However, we continued to visit all of the plots throughout the summer. At each plot, mushrooms (epigeous or above-ground fungi) were collected. Habitat characteristics (such as species composition, DBH, and canopy closure) were measured at each of the food resource sites in the TR habitat. Measurement of habitat characteristics at the remaining SF plots will continue in 1997.

Weather data was continually collected by two computerized weather stations, one each in the TR and SF habitats. During the winter months, snow depths were recorded from several sites throughout the monitored areas.

The Monitoring Program has developed and is maintaining a database using Global Positioning System (GPS) and Geographic Information System (GIS) applications. By the end of 1996, most of the middens on the monitored areas have been located and mapped using GPS, in addition to roads, trails, MGIO, and the CP fire boundary within the monitored areas. This effort will continue until all significant features are included in the database.

All use of the terms *construction* or *construction areas* refers to those areas within 300 m of previous MGIO construction activity. All use of the terms *red squirrel* or *squirrel* refers to the Mt. Graham red squirrel unless otherwise noted.

METHODS

Red squirrels cache conifer cones in selected locations known as middens. Middens are easily recognized by the presence of cached cones and piles of discarded cone scales. The Monitoring Program defines a midden site as a circle with a 10 m radius surrounding the center of the primary cache site. Because red squirrels are territorial and generally solitary, counts of occupied middens provide a reasonably accurate estimate of population size (Smith 1968; Vahle 1978).

All monitored areas are surveyed during census months to locate newly established middens. In addition, new middens are also discovered during other monitoring activities. All known midden sites are marked with numbered metal tags, and black and orange striped flagging.

All statistical analyses were conducted using standard tests found in SAS statistical software (SAS 1988 a,b). The significance level for all tests was $P \leq 0.05$.

Red Squirrel Food Resources

Conifer Seed Production

The Monitoring Program began collecting quantitative data in 1993 to determine the abundance of some red squirrel food resources. Conifer seeds and mushrooms were selected because they provide the majority of the red squirrels' diet and are readily sampled. As in past years, seed production was estimated from 35 seedfall plots distributed among the monitored areas (Figure 1). Three 0.25 m^2 seed traps were randomly placed within a 10 m x 10 m plot at each location. The contents of the seed traps (1995 seed crop) were collected in April prior to the CP fire. The conifer seeds contained in each trap were separated by species and individually squashed to determine the proportion of seeds that are likely to be viable. A viable seed leaves an oily spot on clean paper when squashed. This method is likely to underestimate the total number of viable seeds because some seeds may have been preyed upon within the trap. Estimates of the seedfall for each conifer species were calculated as the average number of viable seeds from all three traps on each plot. The seeds of white pine and ponderosa pine are not readily dispersed by wind due to their large size. Because of this, the crops of these species are under represented in the seed trap samples. Both of these species may be important local food supplies for red squirrels, but at present there is no reliable method for estimating the size of the crops. Seven food resource plots on the TRC area and four plots on the SFC were destroyed or severely damaged in the CP fire. An additional food resource plot was added to the TRC area in the fall of 1996 to compensate for the

heavy losses on that area.

Mushroom Production

The seed plot locations also serve as the center for mushroom collection. As in previous years, mushrooms were collected from plots 1 m by 100 m (0.01 ha) at two week intervals, from June through October. Like the seed plots, 11 of 35 mushroom plots were destroyed or damaged in the CP fire. We re-marked and continued to visit the burned plots throughout the field season and will continue to do so in the future to assess mushroom recovery in these areas. These plots are oriented east to west and centered on seed collection plots. Collections were restricted to genera of mushrooms used by red squirrels on Mt. Graham or in other regions (Table 1). Collected mushrooms were separated by plot and genus, and the wet weights were measured. The mushrooms were then dried and dry weights were measured for energetic analyses.

Energetics of Selected Food Resources

The total number of viable seeds or weight of mushrooms does not provide an equitable comparison within or among areas because different species vary greatly in size, weight, and energy content. The energy content of each food type was calculated and the proportional contribution of each of the food resources was determined. The calculations were made using energy content data from Smith (1981) (Table 2). Energy content was also used to estimate the total energy available (MJ/ha) on each area. An index of total energy available to squirrels was made by combining the total energy of conifer seeds and mushrooms from the same year. Conifer seeds and mushrooms were used to estimate total energy available because they are the primary food sources of red squirrels, they become available at about the same time of year (late summer and autumn), and they provide the majority of the stored food reserves of red squirrels. Standard parametric statistical tests were used in all comparisons.

Because seeds for a given year are not collected and analyzed until the following spring, there is a one year delay in the presentation of seed and energy data. Consequently, the previous year's seed, mushroom, and energy data are reported in addition to the current year's mushroom data.

Population Biology

Midden Occupancy

Census data were used to determine the number and distribution of occupied middens on each monitored area. In 1996, in February, April, June, September, and December, all middens were visited at least once to determine occupancy. If a midden appeared to be occupied on the basis

of feeding sign (cone scales, dried mushrooms, and conifer clippings) or caching, every attempt was made to observe the squirrel and to determine its sex, age, and reproductive condition. During winter months, visual verification was often not practical, and determination of occupancy, in some cases, was based on the presence and age of feeding sign, tracks, and snow tunnels.

All middens on the monitored areas were classified as either occupied, unoccupied, or questionably occupied, with an occupied midden representing one squirrel. A midden was considered to be unoccupied when there was no squirrel or squirrel sign present. A midden was considered to be questionably occupied when red squirrel sign was found but the sign was insufficient to clearly indicate occupancy. Questionably occupied middens were considered to be unoccupied when determining population size. Population size estimates are conservative and represent the minimum number known alive (Krebs 1966). Differences in midden occupancy among study areas and midden occupancy relative to distance from construction were compared using data from April (pre CP fire), June and December.

Midden Turnover and Overwinter Survival

Midden turnover was not estimated due to the CP fire and the non-consecutive census months in 1996. Overwinter survival, however, was estimated for squirrels in the monitored areas. During a complete census in December 1995, the number of occupied middens and the sexes of resident squirrels were determined. The December occupancy was then compared to occupancy for April 1996 (pre CP fire). A squirrel was considered to have survived the winter if it was a resident of a midden in December and that same midden was found to be occupied by a squirrel of the same sex in April. In addition, if the midden was listed as occupied or squirrel seen, it was also counted as a survival.

Spatial Distribution

Three methods were used to describe the spatial distribution of middens and squirrels: crude density, local density, and nearest-neighbor distance. Crude density represents the total number of middens and squirrels per hectare. No allowance was made for differences in habitat quality among the monitored areas, and statistical tests are not appropriate.

Local density (LD) is a method of describing local population densities for comparisons among populations in which habitat variables are uncontrolled. For this report, LD is defined as the number of *middens* or *squirrels* within 100 m of a focal *midden* or *squirrel*. The mean LD ($\bar{x}$ LD) of *middens* (all middens, occupied and unoccupied) and *squirrels* (all occupied middens) is compared between areas and habitats. The benefit of using LD is that these measurements of density are not influenced by habitat variables, whereas crude density may include large areas not suitable as squirrel habitat, such as clearings and meadows. The LD method is adapted from

distance models of neighborhood modeling used by plant ecologists to describe and compare plant populations (Czárán and Bartha 1992). A circle with a radius of 100 m encloses 3.14 hectares, which is approximately the average home range of Mt. Graham red squirrels (Froehlich 1990). It is also about the approximate maximum distance that an observer can recognize and accurately locate a squirrel "chatter" call (P. Young, pers. obs.).

Nearest neighbor distance (NND) was used to describe and compare the spatial distribution of populations and communities of plants and animals (Clark and Evans 1954, Krebs 1989). In this report, NND is the shortest distance, expressed in meters, from a focal *midden* or *squirrel* to the nearest *midden* or *squirrel*. The mean NND ($\bar{x}$ NND) of middens and squirrels was compared between areas and habitats.

Local density and NND, determined for each midden and squirrel from the mapped coordinates, were compared among areas and habitats using ANOVA tests. To determine the LDs and NNDs of some of the middens and squirrels on the monitored areas, it was necessary to include some off-area middens that were within 100 m of a focal midden.

Reproductive Activity and Success

In the 1996 breeding season, the breeding condition of adult male and female squirrels was recorded, and litter activity was noted during normal monitoring activities. By examining nipple condition through binoculars, the reproductive status of a female was determined to be non-breeding, lactating, or post-lactating. The reproductive status of male squirrels was also determined by visual assessment and was recorded as “testes non-scrotal” (non-reproductive) or “testes scrotal” (sexually active).

Trapping and Marking

There was no trapping and marking during the 1996 field season.

Midden Mapping

Almost all middens and other physical features on the monitored areas have been mapped using GPS. Universal Transverse Mercator (UTM) coordinates from the GPS files were used to compute local densities and nearest neighbor distances.

GPS data were collected using the Pathfinder Pro system from Trimble Navigation, Inc. Readings were taken within 5 meters of the midden center. Date, time, and location descriptions were noted in the field for later reference. Final midden locations were based on an average from a minimum of 200 three-dimensional data points. Locations were differentially corrected using base station (Federal Building, Tucson, AZ) files provided by the Forest Service. Maps were produced using PC-ARC Info and Arc-View (ESRI 1995).

Weather Data

Weather data were collected using two Davis Instruments weather stations. One station was located along the abandoned Forest Service road north of Emerald Peak on the SFC area; the other was located at the Biology Camp on the TRC area. The stations record air temperature (high, low, and average), wind speed, wind direction, and rainfall. In addition, the station at the Biology Camp records relative humidity and barometric pressure. Data were collected at 15 minute intervals until April 1996. After April, the stations were re-set to record at 30 minute intervals. Snow depth (cm) was recorded from four snow pole pairs located in the SF habitat, one pair at the 3050 m level on the access road, and three snow pole pairs in the TR habitat. Each pair consists of a pole in a clearing or canopy opening and a second pole nearby in the forest.

Removal of Middens From Regular Censusing

In 1996, after a meeting of an interagency committee, it was decided that there should be specific criteria for the addition and removal of middens from the Mt. Graham midden database. The criteria used by the RSMP for adding and removing middens is somewhat different from, but compatible with, the criteria used by Arizona Game and Fish/Forest Service. These distinctions are based on different censusing methods (RSMP does complete counts <u>not</u> population estimates), and the much more extensive and detailed history of use for all middens on the monitored areas. After an examination of midden history on the monitored areas, the criteria listed below were derived. Thirty-six months of censusing was used as a minimum period of time because roughly half (51%) of the RSMP middens have been censused at least this long.

At the end of 1996, if a midden had been censused for at least 36 months, was occupied less than 10% of months censused and was not occupied in 1996, it was dropped from regular censusing. These middens will be checked for activity in December 1997 and added back to the current census list if necessary.

After 1996, at the end of each calender year, a list of middens to be removed from regular censusing will be compiled. The criteria for removal after 1996 is slightly different than listed above based on a new census schedule to be implemented in 1997. If a midden has been censused for at least three years (12 censuses), including at least one "good" cone year, and has not been occupied during that time, it will be removed from the census list. These removed middens will checked once a year during the winter (December) census. If any of these middens become re-occupied, they will be added back to the census list.

RESULTS AND DISCUSSION

Red Squirrel Food Resources

1995 Conifer Seed Production

As seen in previous years, the composition of the 1995 conifer seed crop varied within and among the monitored areas. Engelmann spruce seeds were the most abundant resource in numbers of seeds/ha on all of the monitored areas. Engelmann spruce seeds, on average, accounted for 71% of the seed fall in the TR habitat and 85% of the seed fall in the SF habitat. Corkbark fir seeds were the next most abundant resource on all of the areas. Corkbark fir seeds, on average, accounted for 21% of the seed fall in the TR habitat, and 15% of the seed fall in the SF habitat. Douglas-fir was the least abundant resource on all four areas. Douglas-fir seeds accounted for < 0.1% of the seed fall in the SF habitat, but represented 8% of the seed fall in the TR habitat (Table 3, Appendix A). White pine and ponderosa pine were not represented in the samples collected from any of the plots.

The 1995 overall seed crop was the largest seen in three years of data collection. There was a considerably larger Engelmann spruce crop in 1995, as compared to 1994 and 1993, on all of the monitored areas. On all areas, corkbark fir crops in 1995 were larger than those in 1994. In the TR habitat, the 1995 corkbark fir crop was less than the 1993 crop. In the SF habitat, however, the 1995 corkbark fir crop was larger. For Douglas-fir, all areas except the SFN had a larger crop in 1995 than in 1994. In comparison to the 1993 crop, however, all areas had a smaller seed crop in 1995 (Figure 3 a-c).

1996 Mushroom Production

Mushroom transects on the TRC and SFC areas that were burned in the CP fire were surveyed during the 1996 field season, to assess of the recovery of mushrooms following the fire. There was essentially no production of mushrooms on the burned transects in 1996. The mushroom production on all areas, excluding burned transects, was three to seven times greater in 1996 than in 1995. If all burned transects on the TRC and SFC areas (little or no production) are included, there was still greater production in 1996 than in 1995 on all areas except the TRC area (Figure 4a,b).

The mean annual mushroom production was significantly greater on the SFN area in comparison to the other three areas. There was considerably greater production on the SFN area with or without the unburned transects included in the analysis (Table 4, 4a).

When considering only the unburned transects, three genera, *Russula*, *Leccinum*, and *Lycoperdon*, accounted for 83% of production on the TRC area. On the TRN area, *Russula*, *Cortinarius*, and *Lactarius* accounted for 74% of total production. The same three genera, *Russula*, *Leccinum*, and *Cortinarius*, accounted for 70% and 64% of the production, respectively, on the SFC and SFN areas. By including *Amanita* on the SFN, 76% of the total production was accounted for on this area. These same patterns are seen when all transects are included in the analysis (Table 5, 5a).

Energetics of Selected Food Resources in 1995

Conifer seeds from the 1995 seed crop were collected prior to the CP fire. Total estimated energy available from the 1995 conifer seed and mushroom crops was similar between areas within each habitat. However, there were significant differences between habitats for total energy and the energy available from all three seed types. For Engelmann spruce and Corkbark fir, there was significantly more energy available in the SF habitat than the TR habitat. For Douglas-fir there was significantly more energy available in the TR habitat than in the SF habitat (Table 6).

For mushrooms, the largest amount of energy available was on the SFN area. The TRC had the next largest amount of available energy. The TRN and SFC had similar amounts of energy available from mushrooms, the least of the four areas (Table 6). In contrast to 1994, when mushrooms accounted for most of the available energy, seeds accounted for 80% to 98% of the total energy on the monitored areas in 1995 (Figure 5).

To compare the 1995 food resources found within the monitored areas, the areas were divided into polygons enclosing each food resource plot. Boundaries between polygons were drawn along the midpoints between adjacent plots so that each area contained all the area that was closer to the sample plot than any other. In all polygons in the TR habitat, the total energy available in 1995 was relatively low, less than 500 MJ/ha. On the SFC area, over half of the polygons had more than 1000 MJ/ha and one polygon had more than 2000 MJ/ha of available energy. The SFN area, as in 1994, had the most available energy of all the areas. All but one polygon had over 1000 MJ/ha of energy available and seven of the twelve polygons had over 1500 MJ/ha available. The SFN area had the highest amount of available energy from both seeds and mushrooms of all the areas (Figure 6).

Population Biology

Midden Occupancy

The first census of the year was 12-17 February, and the second census was 22-24 April. The April census was finished the day that the CP fire started in the Riggs Lake area. Full-time monitoring was resumed after the CP fire on 3 June when a census and fire damage assessment was begun.

From December 1995 to December 1996, the number of red squirrels on the monitored areas dropped from 237 to 147, a 38% decrease. On the TRC area, the highest number of squirrels was seen in February 1996 (32), and the lowest number was 14 squirrels in June after the CP fire. The population of the TRC increased slightly by the end of the year to 17 squirrels. The number of squirrels on the TRN area remained fairly steady throughout the year (15 or 16 squirrels). The number of squirrels on the SFC area was highest in February (106) and the number of squirrels in June after the CP fire was 76 squirrels. The SFC population reached a low point of 55 squirrels in December. The population on the SFN area was again highest in February (84) and slowly declined throughout the year to 60 squirrels in December (Figure 7, Appendix B,C,D).

Twenty-three middens on the TRC area and ten middens on the SFC area were completely destroyed in the CP fire. Thirty middens had some fire damage (ranging from spot fires to intense ground fires) within 15 meters and 24 middens had some type of fire suppression (from hand lines to trees cut in the center of the midden) damage within 15 meters. Seven middens had both fire and suppression damage within 15 meters (Appendix E).

There were 20 new middens found on the monitored areas in 1996. Three new middens were located on the TRC area after the CP fire. On the TRN area, two new middens were found before the fire and three were found after the fire (one midden was probably established the previous winter but found in June). Three new middens were located on the SFC area prior to the CP fire and one was found after (one midden was probably established the previous winter but found in June). On the SFN area, six new middens were found before the fire and two were found after (Table 7).

The distribution of middens and squirrels among the four monitored areas did not markedly change before and after the CP fire, other than on the TRC area. This area had the most area and number of middens destroyed in the fire and subsequently had a smaller proportion of middens and squirrels among the areas (Table 8). The distributions of middens and squirrels remained fairly stable from June to December (Table 8a).

In April 1996, prior to the CP fire, there was a significantly greater proportion of middens occupied on the SFC area than on the SFN area. There was no significant difference in the

proportion of middens occupied within the TR habitat. This same pattern was found in June, after the CP fire. The SFC area had a greater proportion of occupied middens than the SFN in both April and June. This is opposite of expected if the CP fire and/ or construction were affecting midden occupancy. By December, there were no significant differences in the proportion of middens occupied within or between the TR and SF habitats (Table 9). As in previous years, when the population was declining in the fall, there were no significant differences in the proportion of middens occupied among the areas.

The average distance of occupied middens from construction in April (pre- CP fire) and June was shorter, though not significantly, than the average distance of unoccupied middens from construction on both the TRC and SFC areas. Distances of both occupied and unoccupied middens on the TRC area were farther from construction after the CP fire because most of the middens destroyed were near the telescope access road. In December, the distance from construction of occupied and unoccupied middens was nearly the same on the TRC area. On the SFC area in December, the average distance of occupied middens from construction was slightly, though not significantly, farther than that of unoccupied middens (Table 10).

Midden Turnover and Overwinter Survival

Midden turnover was not estimated in 1996 due to the CP fire and non-consecutive census months. There were no significant differences in the number of squirrels (marked and unmarked) that survived the winter of 1995-1996 within or between the TR and SF habitats. Overwinter survival for the TR habitat in 1995-1996 was the highest (80%) in six years of data collection. Overwinter survival in the SF habitat (74%) was the third highest for that habitat. Survival on the TRN area (93%) was the highest among all areas in the six years of data collection (Table 11).

Overwinter survival of marked squirrels was also very high in 1995-1996. There were nine marked (tagged, naturally marked, and radio collared) squirrels for which a determination of their overwinter survival could be made. Of these nine squirrels, only one disappeared from the monitored areas in April, a survival of 89%.

Overwinter survival may be overestimated because a midden may be occupied in the spring by a different squirrel of the same sex. This mortality can not be detected among unmarked squirrels. The accuracy and biological value of overwinter survival estimates can be improved by having more marked squirrels on the monitored areas.

Spatial Distribution

Crude Density

The crude density of middens and squirrels was plotted to provide a visual representation of the potential (number of middens) versus actual (number of squirrels) midden occupancy (Figure 8). The crude density of *middens* increased slightly on all areas between December 1995 and December 1996. On the TRC area, the crude density of *middens* changed very little after the fire because nearly equal proportions of area (41%) and middens (43%) were destroyed in the fire. The large increase in the density of middens from April to June on the SFC area is a result of a more disproportionate loss of area (25%) and middens (7%). Increases seen on the areas unaffected by the CP fire were due to the addition of new middens throughout 1996 (Figure 8, Appendix F-1a).

The crude density of *squirrels* decreased slightly on all areas from December 1995 to December 1996. This is a reflection of the overall drop in the numbers of squirrels on the monitored areas. On the two areas affected by the CP fire, crude densities of squirrels appear to reflect the relative area and intensity of damage on each area. The TRC lost areas of relatively high midden density, resulting in a decrease in crude density of squirrels. The SFC lost areas with few middens, and a decrease in squirrel crude density also was seen (Figure 8, Appendix F1-b).

Local Density

The December 1996 mean local density ($\bar{x}$ LD) of *middens* on all areas was 4.7, the same as in December 1995. Middens on the SFC area had a significantly higher $\bar{x}$ LD than middens on the SFN in December 1996. This is the same pattern that was seen in 1995. However, as in 1994 and 1995, no significant difference was found between construction and non-construction areas in the TR habitat. The effects of the CP fire on the $\bar{x}$ LD of middens were greatest on the TRC area. The $\bar{x}$ LD of middens dropped from 5.1 in April to 3.7 in June. This decrease was because most of the middens lost on the TRC were located close together on the east side of the area. In contrast, the middens destroyed on the SFC area were more isolated with fewer nearby middens. The $\bar{x}$ LD of middens on the SFC area increased slightly from April (5.7) to June (5.9). The addition of new middens (20 on all areas) in 1996 did not greatly change the $\bar{x}$ LD of middens on the monitored areas (Table 12, Figure 9, Appendix F-2).

Between December 1995 and December 1996, there was an overall decrease in the $\bar{x}$ LD of *squirrels* on all areas. The greatest decrease was on the TRC area and in some part due to the greater loss of middens in the CP fire. The $\bar{x}$ LD of squirrels was significantly greater on the TRN area than on the TRC area. In contrast, the $\bar{x}$ LD of squirrels on the construction area in the SF habitat was significantly greater than on the non-construction area (Table 12, Figure 9, Appendix F-2).

Nearest Neighbor Distance

From December 1995 to December 1996, the $\bar{x}$ NND of *middens* decreased slightly (<4 m) on all areas except the TRC, where a slight (1.1 m) increase was seen. This again may be due in some part the high number of middens in close proximity to one and another that were destroyed in the CP fire. Within the TR habitat, the $\bar{x}$ NND was shorter on the TRN area than on the TRC area. Within the SF habitat, the $\bar{x}$ NND was shorter on the SFC area than on the SFN area. This is the same pattern that was seen in December 1995. The $\bar{x}$ NND was not greatly changed on the SFC area after the CP fire, because most of the middens destroyed were more isolated with few neighboring middens (Table 13, Figure 10, Appendix F-2).

The $\bar{x}$ NND of *squirrels* increased from December 1995 to December 1996 on all areas except the TRN area where a slight decrease was seen. The $\bar{x}$ NND was significantly shorter on the TRN area than on the TRC area. In contrast, the construction area in the SF habitat had a significantly shorter $\bar{x}$ NND than the non-construction area (Table 13, Figure 10, Appendix F-2).

Reproductive Activity and Success

One breeding chase was observed in 1996, on 24 April, on the SFN area. The resident female and three scrotal males were seen chasing and vocalizing all around the midden (Appendix G-1). The earliest date a scrotal male was seen was 13 February in the TR habitat, and most of the males seen during the February census were scrotal. The latest data a scrotal male was seen was 24 August on the SFC area. However, most of the males seen during July and August did not appear to be scrotal.

The earliest a lactating female was observed was 22 April on the TRC area and the latest was on 14 July, also on the TRC area. Evidence of 13 litters was seen during censuses or other monitoring activities. The earliest date evidence of a litter was seen was 22 April on the TRC area when a lactating female was seen carrying a small pink baby into a hollow log. The latest date evidence of a litter was seen was 10 July on the SFC area when a marked lactating female and emerged juvenile were seen in their midden (Appendix G-2).

Trapping and Marking

There was no trapping and marking on the monitored areas in 1996 due to time constraints imposed by additional field work resulting from the CP fire. Trapping is planned to resume during the 1997 field season.

Marked Squirrels

There were 11 marked squirrels, including a radio-collared squirrel from a previous Arizona Game and Fish (AGFD) study, seen on the monitored areas in February 1996. This included a marked male (-/R) that had not been seen since he was tagged in October 1995. A second marked male (W/-) that had also not been seen since tagging in October 1995, was seen in March 1996. By December 1996, four marked squirrels (including the radio collared squirrel) remained, all on the SFC area (Appendix D). In addition to the tagged or radio collared squirrels, there were 24 squirrels on or near the monitored areas in 1996 with natural identifying marks such as an ear notch or a short tail (Appendix H-1). Seven of these squirrels were seen in December 1996. Of the two radio-collared squirrels from the AGFD study on the monitored areas at the end of 1995, only one was seen during 1996.

Eight marked squirrels disappeared from the monitored areas from February through July 1996. Two females on the TRC area that had been tagged as young of the year in September 1992 were last seen on the areas in February 1996. These two females had been known on the areas for 53 months. Both of these females' middens were considered active in April 1996, before the CP fire, but positive ID of the marked squirrels was not made. One of these middens was completely destroyed in the CP fire (Appendix H-2).

Four marked squirrels were observed outside their midden in territorial chases and foraging. The squirrels were seen from 32 to 55 meters from their own middens (Appendix H-3).

One marked male squirrel was tagged at midden 3367 in October 1995, but was not seen in December 1995. However, in February 1996, he was resident at midden 3365. In March, this squirrel was replaced at midden 3365 by another marked male who was also not seen since being tagged in October 1995 at midden 3361 (Appendix H-4). The second marked male at midden 3365 appeared also to be defending midden 3020 located 59 m from his primary midden. He was observed chattering and chasing other squirrels out of both midden areas in June and July until a female squirrel finally became resident at midden 3020 (Appendix H-5).

Midden Mapping

At the end of 1996, all but five of the middens on the monitored areas had been mapped using GPS. All of the middens that were destroyed in the CP fire were mapped prior to the fire. Work continued on referencing physical features such as trails and old logging roads. In addition, the boundaries of intensely burned areas from the CP fire were mapped as well as fire suppression features such as hand and dozer lines (Figure 2).

Weather Data

Weather data were collected nearly continuously in 1996, from two weather stations located at the Biology Camp (TR habitat) and near Emerald Peak (SF habitat). The maximum temperature recorded was 34.0°C in June at the Biology Camp and the minimum temperature recorded was -13.7°C in December on Emerald Peak. The maximum average monthly temperature was 15.8°C in June at the Biology Camp and the minimum average monthly temperature was -2.1°C in December on Emerald Peak. Average monthly temperatures on Emerald Peak were from 0.6°C to 4.3°C cooler than the recorded temperatures at the Biology Camp and the greatest differences were seen during the summer months (Figure 11, Appendix I-1). The maximum rainfall at both stations was recorded in September, with 124.1 mm at the Biology Camp and 115.0 mm at Emerald Peak (Figure 12, Appendix I-2). May was the driest month with no rain at the Biology Camp and only 0.2 mm on Emerald Peak. Snow depth data was also recorded from the eight pairs of snow poles on the monitored areas. There was little snow on the monitored areas in the winter of 1995-1996 (Figure 13, Appendix I-3). The average monthly snow depth from January through March 1996 ranged from 6 cm to 40 cm as compared to 127 cm to 192 cm during the same time period in 1995. In November and December 1996, the average monthly snow depth ranged from 0 cm to 42 cm (Appendix I-3). Data on wind chill temperatures, wind direction and speed, humidity, and barometric pressure were also collected (Appendix I-4,5,6).

Removal of Middens from Regular Censusing

After the last full census of 1996, in December, a list of middens was compiled to be removed from regular censusing. Twenty-five middens with low occupancy, most of them on the SFN area, met the criteria for removal and will not be included in regular censuses until December 1997 (Appendix J-1). If any of these middens are found to be occupied at that time, they will be added back to the regular census list. In addition, the 33 middens completely burned in the CP fire will be permanently removed from the census list (Appendix J-2).

LITERATURE CITED

Clark, P.J. and F.C. Evans. 1954. Distance to nearest neighbor as a measure of spatial relationships in populations. Ecol., 35:445-453.

Czárán, T. and S. Bartha. 1992. Spatiotemporal dynamic models of plant populations and communities. Trends in Ecol. and Evol., 7:38-42.

ESRI 1995. ARC View and ARC/Info Users Manuals. Environmental Systems Research Institute. Redlands, CA.

Froehlich, G.F. 1990. Habitat use and life history of the Mt. Graham red squirrel. M.S.Thesis, Univ. of Arizona, Tucson, 61 pp.

Krebs, C.J. 1966. Demographic changes in fluctuating populations of *Microtus californicus*. Ecological Monographs 36:239-273.

Krebs, C.J. 1989. Ecological Methodology. Harper and Row, New York, 654 pp.

SAS 1988a. SAS/STAT User's Guide. Release 6.03 edition. SAS Institute Inc., Cary, NC 1028 pp.

SAS 1988b. SAS Procedures Guide. Release 6.03 edition. SAS Institute Inc., Cary, NC 441 pp.

Smith, C.C. 1968. The adaptive nature of social organization in the genus of three squirrels *Tamiasciurus*. Ecol. Monogr., 38:31-63.

Smith, C.C. 1981. The indivisible niche of *Tamiasciurus*: an example of nonpartitioning of resources. Ecol. Monogr., 51:343-363.

USDA Forest Service. 1989. Mount Graham International Observatory Management Plan. Coronado National Forest, Tucson, 38 pp.

Vahle, J.R. 1978. Red squirrel use of southwestern mixed coniferous habitat. Master's Thesis, Arizona State University, Tempe, 100 pp.

Table 1. Mushroom genera known to be food resources of red squirrels, and collected from the food resource plots.

MUSHROOM GENUS	SOURCE(S)
Amanita	Buller 1920, M.C. Smith 1968
Auricularia	Monitoring Program personal observations
Boletus	Buller 1920, C.C. Smith 1968, M.C. Smith 1968
Clavaria	M.C. Smith 1968
Clitocybe	Monitoring Program personal observations
Cortinarius	C.C. Smith 1968, Froehlich 1990, Uphoff 1990
Gastroid sp.	Monitoring Program personal observations, States 1990
Hydnum	C.C. Smith 1968, M.C. Smith 1968
Lactarius	Buller 1920, C.C. Smith 1968
Leccinum	Monitoring Program personal observations
Lycoperdon	Monitoring Program personal observations
Pholiota	C.C. Smith 1968
Ramaria	Monitoring Program personal observations
Russula	M.C. Smith 1968, C.C. Smith 1968
Suillus	C.C. Smith 1968

Table 2. Energy content of some red squirrel food resources. (Source: C. Smith 1981)

Food Resource	Unit	($\bar{x}$ mg/seed)	Energy Content (kJ/unit)
Engelmann spruce	seed	3.7	0.091
Corkbark fir	seed	18.6	0.444
Douglas-fir	seed	8.7	0.192
Mushroom	mg dry weight		0.018

Table 3. Mean viable conifer seed production, 1995.

	Engelmann spruce		Corkbark fir		Douglas-fir	
Area/Habitat	$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%
TRC	586.7	65.9	214.8	24.1	88.9	10.0
TRN	890.0	81.7	160.0	14.7	40.0	3.7
SFC	6106.7	80.3	1489.3	19.6	6.7	<0.1
SFN	9633.3	87.8	1338.9	12.2	0.0	0.0
TR Habitat	680.0	71.5	197.9	20.8	73.8	7.8
SF Habitat	8030.3	85.1	1407.3	14.9	3.0	<0.1

Table 4. Mean annual mushroom production, 1996. (unburned transects only)

Area/Habitat	n	$\bar{x}$ Wet weight (Kg/ha)	$\bar{x}$ Dry weight (Kg/ha)	$\bar{x}$ Energy content (MJ/ha)
TRC	2	56.220 ± 4.6800[a]	5.775 ± 0.0350[a]	104.0 ± 0.63[a]
TRN	4	51.375 ± 17.2500[a]	4.961 ± 1.4707[a]	89.3 ± 26.47[a]
SFC	6	84.618 ± 10.2576[a]	8.953 ± 1.0873[a]	161.2 ± 19.57[a]
SFN	12	196.351 ± 31.1875[a]	18.641 ± 2.8705[a]	335.5 ± 51.67[a]
TR Habitat	6	52.990 ± 11.0240	5.233 ± 0.9459	94.2 ± 17.03
SF Habitat	18	159.107 ± 24.3534	15.412 ± 2.2130	277.4 ± 39.83

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[a] Means with the same letter indicate no significant difference. In some cases a difference between means is seen using ANOVA, but no difference is seen in the multiple range test (a,b,c) because the variance of the samples is too large.

ANOVA

Wet Weight	F = 4.96	df = 3	***P = 0.0098***
Dry Weight	F = 4.89	df = 3	***P = 0.0104***
Energy	F = 4.89	df = 3	***P = 0.0104***

Table 4a. Mean annual mushroom production, 1996. (all transects)

Area/Habitat	n	$\bar{x}$ Wet weight (Kg/ha)	$\bar{x}$ Dry weight (Kg/ha)	$\bar{x}$ Energy content (MJ/ha)
TRC	9	12.576 ± 8.2852[b]	1.294 ± 0.8468[b]	23.3 ± 15.24[b]
TRN	4	51.375 ± 17.2500[b]	4.961 ± 1.4707[b]	89.3 ± 26.47[b]
SFC	10	53.912 ± 14.1480[b]	5.754 ± 1.4899[b]	103.6 ± 26.82[b]
SFN	12	196.351 ± 31.1875[a]	18.641 ± 2.8705[a]	335.5 ± 51.67[a]
TR Habitat	13	24.514 ± 9.0164	2.423 ± 0.8579	43.6 ± 15.44
SF Habitat	22	131.606 ± 23.5888	12.783 ± 2.1789	230.1 ± 39.22

[a,b] Means with the same letter indicate no significant difference. In some cases a difference between means is seen using ANOVA, but no difference is seen in the multiple range test (a,b,c) because the variance of the samples is too large.

ANOVA

Wet Weight	F = 13.91	df = 3	***P = 0.0001***
Dry Weight	F = 13.78	df = 3	***P = 0.0001***
Energy	F = 13.78	df = 3	***P = 0.0001***

Table 5. Mean annual mushroom production (wet weight) of selected mushroom genera known to be food resources for red squirrels, 1996. (unburned transects only) The proportions of the three or four most available genera on each area are in bold.

	TRC		TRN		SFC		SFN	
Genus	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%
Amanita	0.000	0.0	2.063	4.0	1.163	1.4	23.027	**11.7**
Auricularia	0.000	0.0	4.988	9.7	0.077	0.1	0.010	<0.1
Boletus	0.000	0.0	0.000	0.0	0.000	0.0	3.198	1.6
Clavaria	0.000	0.0	0.000	0.0	0.000	0.0	0.021	<0.1
Clitocybe	4.635	8.2	0.485	0.9	0.000	0.0	0.438	0.2
Cortinarius	4.430	7.9	10.118	**19.7**	21.888	**25.9**	30.333	**15.4**
Gastroid sp.	0.000	0.0	0.000	0.0	9.083	10.7	1.867	1.0
Hydnum	0.000	0.0	0.000	0.0	6.953	8.2	6.573	3.3
Lactarius	0.000	0.0	5.683	**11.1**	1.403	1.7	6.656	3.4
Leccinum	8.260	**14.7**	0.000	0.0	16.520	**19.5**	43.894	**22.4**
Lycoperdon	13.780	**24.5**	4.323	8.4	2.807	3.3	2.390	1.2
Pholiota	0.440	0.8	0.630	1.2	0.660	0.8	0.657	0.3
Ramaria	0.000	0.0	0.680	1.3	4.587	5.4	22.695	**11.6**
Russula	24.675	**43.9**	21.968	**42.8**	19.477	**23.0**	50.978	**26.0**
Suillus	0.000	0.0	0.440	0.9	0.000	0.0	3.615	1.8
Total	56.220		51.375		84.618		196.351	

Table 5a. Mean annual mushroom production (wet weight) of selected mushroom genera known to be food resources for red squirrels, 1996. (all transects) The proportions of the three or four most available genera on each area are in bold.

	TRC		TRN		SFC		SFN	
Genus	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%
Amanita	0.000	0.0	2.063	4.0	0.698	1.3	23.027	**11.7**
Auricularia	0.000	0.0	4.988	9.7	0.046	0.1	0.010	<0.1
Boletus	0.000	0.0	0.000	0.0	0.000	0.0	3.198	1.6
Clavaria	0.000	0.0	0.000	0.0	0.000	0.0	0.021	<0.1
Clitocybe	1.030	8.2	0.485	0.9	0.000	0.0	0.438	0.2
Cortinarius	0.984	7.8	10.118	**19.7**	13.789	**25.6**	30.333	**15.4**
Gastroid sp.	0.000	0.0	0.000	0.0	5.450	10.1	1.867	1.0
Hydnum	0.000	0.0	0.000	0.0	4.172	7.7	6.573	3.3
Lactarius	0.000	0.0	5.683	**11.1**	0.842	1.6	6.656	3.4
Leccinum	1.836	**14.6**	0.000	0.0	9.912	**18.3**	43.894	**22.4**
Lycoperdon	3.144	**25.0**	4.323	8.4	1.684	3.1	2.390	1.2
Pholiota	0.098	0.8	0.630	1.2	0.505	0.9	0.657	0.3
Ramaria	0.000	0.0	0.680	1.3	2.752	5.1	22.695	**11.6**
Russula	5.483	**43.6**	21.968	**42.8**	14.062	**26.0**	50.978	**26.0**
Suillus	0.000	0.0	0.440	0.9	0.000	0.0	3.615	1.8
Total	12.576		51.375		53.912		196.351	

Table 6. Estimated mean energy from four primary food resources, 1995. (all transects)

Area/Habitat	N	Engelmann spruce	Corkbark fir	Douglas-fir	Total Seeds	Total Mushrooms	Total Energy
				$\bar{x}$ MJ/ha ± se			
TRC	9	53.4 ± 20.30[b]	95.4 ± 39.73[a]	17.1 ±5.94[a]	165.8 ± 42.45[b]	44.4 ± 11.46[a]	207.2 ± 44.18[b]
TRN	4	81.0 ± 35.95[b]	71.0 ± 15.85[a]	7.7 ± 6.85[a,b]	159.7 ± 34.03[b]	27.0 ± 8.17[a]	186.8 ± 34.80[b]
SFC	10	555.7 ± 104.77[a]	661.3 ± 194.91[a]	1.3 ± 0.69[b]	1218.3 ±178.59[a]	23.6 ± 3.09[a]	1241.8 ± 178.61[a]
SFN	12	876.6 ± 140.56[a]	594.5 ± 171.28[a]	0.00[b]	1471.1 ± 96.52[a]	55.0 ± 7.49[a]	1526.1 ± 97.64[a]
TR Habitat	13	61.9 ± 17.41	87.9 ± 27.54	14.2 ± 4.63	163.9 ± 30.36	37.0 ± 8.33	200.9 ± 31.65
SF Habitat	22	730.8 ± 94.87	624.8 ± 125.84	0.6 ± 0.33	1356.2 ± 98.13	40.7 ± 5.43	1396.9 ± 99.46

ANOVA - Energy

Englemann Spruce	F = 11.98	df = 3	***P = 0.0001***
Corkbark Fir	F = 3.32	df = 3	***P = 0.0324***
Douglas-fir	F = 5.79	df = 3	***P = 0.0029***
Total Seeds	F = 29.13	df = 3	***P = 0.0001***
Total Mushrooms	F = 3.38	df = 3	***P = 0.0305***
Total Energy	F = 29.25	df = 3	***P = 0.0001***

[a,b] Means with a different letter are significantly different. In some cases a difference between means is seen using ANOVA, but no difference is seen in the multiple range test (a,b) because the variance of the samples is too large.

Table 7. Number and discovery status of red squirrel middens on each of the monitored areas, 1995-1996.

		Midden Status				
Year	Area	Old	Burned[1]	Newly Found	Newly Established	Total Dec 96
1995	TRC	50	-	0	4	54
	TRN	25	-	0	3	28
	SFC	57	-	0	62	119
	SFN	80	-	0	33	113
	Total	212	-	0	102	314
1996	TRC	31	23	0	3	34
	TRN	28	0	0	5	33
	SFC	110[2]	10[3]	0	4[3]	113[3]
	SFN	113	0	0	8	121
	Total	282	33	0	20	301

[1] This column refers to the middens that were completely burned in the Clark Peak Fire.

[2] Midden 3389 remained in the active census list even though the main area of activity (midden shift) was completely burned in the Clark Peak Fire. The main area of activity at midden 3389 had shifted ~ 15 m E of the plaque tree. The plaque tree area remained intact. The old midden site (plaque tree) is still being used by the red squirrel from 3325. Therefore, midden 3389 was included in the old midden status column instead of the burned midden column.

[3] Midden 3021 was a newly established midden in early April and was also completely burned in the Clark Peak Fire. Therefore, midden 3021 was included in the newly established column and the burned midden column.

Table 8. Pre- and post-fire proportion of the total area, total number of middens, and total number of squirrels found on each of the monitored areas, 1996.

	Pre-fire, April 1996						Post-fire, June 1996					
	Area		Middens		Squirrels[1]		Area		Middens		Squirrels[1]	
	ha	%[2]	n	%	n	%	ha	%	n	%	n	%
TRC	83.0	24	54	17	30	14	49.1	18	31[3]	11	14[3]	8
TRN	24.4	7	30	9	15	7	24.4	9	31	11	16	9
SFC	104.6	31	122	38	96	44	76.1	27	113	38	76	45
SFN	128.9	38	119	37	75	35	128.9	46	119	40	63	37
Total	340.9		325		216		278.5		294		169	

[1] Juveniles living with their mothers are not counted in the number of squirrels.

[2] All percentages are rounded to the nearest whole number.

[3] The number of middens in June does not include midden 1135 which was completely burned in the Clark Peak fire. However, the number of squirrels for June does include the male seen several times in midden 1135.

Table 8a. Proportion of the total area, total number of middens, and total number of squirrels found on each of the monitored areas, 1995-1996.

			Jun 1995				Dec 1995			
	Area		Middens		Squirrels[1]		Middens		Squirrels	
	ha	%[2]	n	%	n	%	n	%	n	%
TRC	83.0	24	50	24	22	39	54	17	35	15
TRN	24.4	7	25	12	4	7	28	9	15	6
SFC	104.6	31	57	27	11	19	119	38	105	44
SFN	128.9	38	80	38	20	35	113	36	82	35
Total	340.9		212		57		314		237	

			Jun 1996				Dec 1996			
	Area[3]		Middens		Squirrels		Middens		Squirrels	
	ha	%	n	%	n	%	n	%	n	%
TRC	49.1	18	31[4]	11	14[4]	8	34	11	17	12
TRN	24.4	9	31	11	16	9	33	11	15	10
SFC	76.1	27	113	38	76	45	113	38	55	37
SFN	128.9	46	119	40	63	37	121	40	60	41
Total	278.5		294		169		301		147	

1 Juveniles living with their mothers are not counted in the number of squirrels.

2 All percentages are rounded to the nearest whole number.

3 The monitored area after the Clark Peak Fire.

4 The number of middens in June does not include midden 1135 which was completely burned in the Clark Peak fire. However, the number of squirrels for June does include the male seen several times in midden 1135.

Table 9. Number and percent of available middens *occupied*, 1996.

	April		June		December	
Area/Habitat	n	%	n	%	n	%
TRC	30	56	13[1]	42	17	50
TRN	15	50	16	52	15	45
SFC	96	79	76	67	55	49
SFN	75	63	63	53	60	50
TR Habitat	45	54	29[1]	47	32	48
SF Habitat	171	71	139	60	115	49
TR + SF	216	66	168[1]	57	147	49

Chi Square:

APRIL

within TR	X^2=0.239	df=1	*P*=0.625
within SF	X^2=7.171	df=1	***P=0.007***

JUNE

within TR	X^2=0.583	df=1	*P*=0.445
within SF	X^2=4.946	df=1	***P=0.026***

DECEMBER

within TR	X^2=0.139	df=1	*P*=0.710
within SF	X^2=0.020	df=1	*P*=0.889

[1] Appendix D shows 31 middens on the TRC in June and 14 middens were counted as occupied. Midden 1135 completely burned in the Clark Peak fire but a squirrel was seen several times in this midden as well as going to and from the unburned area about 35 m to the west. It was unclear whether this squirrel was still residing in the burned midden or just feeding in the area. After July, there was no further activity. Midden 1135 was not included in the analysis for this table even though the squirrel was counted in the June occupancy.

Table 10. Mean distance from construction to occupied and unoccupied middens on the TRC and SFC areas, April, June and December 1996.

		April		June		December	
Area	Midden Status	n	$\bar{x}$ ±se (m)	n	$\bar{x}$ ±se (m)	n	$\bar{x}$ ±se (m)
TRC	Occupied	30	179.2 ± 13.44	14[1]	221.6 ± 20.06	17	230.8 ± 21.11
	Unoccupied	24	217.9 ± 15.06	18[1]	240.3 ± 17.10	17	230.1 ± 16.44
SFC	Occupied	96	161.1 ± 8.47	76	163.1 ± 8.92	55	173.1 ± 10.55
	Unoccupied	26	167.2 ± 19.39	37	168.0 ± 16.92	58	156.8 ± 12.27

ANOVA:

APRIL

TRC	F=3.67	df=1	P=0.0610
SFC	F=0.10	df=1	P=0.7486

JUNE

TRC	F=0.51	df=1	P=0.4803
SFC	F=0.08	df=1	P=0.7796

DECEMBER

TRC	F=0.00	df=1	P=0.9783
SFC	F=1.00	df=1	P=0.3203

[1] Appendix D shows 31 middens on the TRC in June and 14 middens were counted as occupied. Midden 1135 completely burned in the Clark Peak fire but a squirrel was seen several times in this midden as well as going to and from the unburned area about 35 m to the west. It was unclear whether this squirrel was still residing in the burned midden or just feeding in the area. After July, there was no further activity. Midden 1135 was included in the analysis for this table.

Table 11. Overwinter survival of red squirrels on the monitored areas, 1995-1996.

Area/Habitat	Number of Squirrels Fall 1995	Number of Squirrels Surviving Spring 1996[1]	% survival
TRC	35	26	74
TRN	15	14	93
SFC	105	79	75
SFN	82	59	72
TR Habitat	50	40	80
SF Habitat	187	138	74

Likelihood Ratio Chi-square test:

within TR	X^2=2.789	df=1	*P*=0.104
within SF	X^2=0.257	df=1	*P*=0.620
between habitats	X^2=0.841	df=1	*P*=0.364

[1] Overwinter survival was calculated for the month of April (pre-fire) on each area.

Table 12. Mean Local Density of middens and red squirrels on the monitored areas, 1995 and 1996.

	December 1995				December 1996			
	Middens		Squirrels		Middens		Squirrels	
Area/Habitat	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se
TRC	54	5.2 ± 0.43[a,b]	35	4.3 ± 0.44[a,b]	34	4.0 ± 0.33[b]	17	1.5 ± 0.23[b]
TRN	28	4.3 ± 0.32[b,c]	15	3.0 ± 0.39[c]	33	4.6 ± 0.28[b]	15	2.6 ± 0.25[a]
SFC	119	5.5 ± 0.24[a]	105	4.9 ± 0.24[a]	113	5.9 ± 0.24[a]	55	3.2 ± 0.24[a]
SFN	113	3.7 ± 0.21[c]	82	3.1 ± 0.22[b,c]	121	3.9 ± 0.17[b]	60	1.5 ± 0.13[b]
TR Habitat	82	4.9 ± 0.30	50	3.9 ± 0.34	67	4.3 ± 0.22	32	2.0 ± 0.20
SF Habitat	232	4.7 ± 0.17	187	4.1 ± 0.18	234	4.9 ± 0.16	115	2.3 ± 0.16
TOTAL	314	4.7 ± 0.15	237	4.0 ± 0.16	301	4.7 ± 0.13	147	2.2 ± 0.13

ANOVA:	**1995**			**1996**		
LD of Middens						
among all areas	F=10.79	df=3	***P=0.0001***	F=19.50	df=3	***P=0.0001***
LD of Squirrels						
among all areas	F=10.44	df=3	***P=0.0001***	F=18.25	df=3	***P=0.0001***

[a,b,c] Means with the same letter(s) are not significantly different. In some cases a difference between means is seen using ANOVA, but no difference is seen in the multiple range test (a,b,c) because the variance of the samples is too large.

Table 13. Mean Nearest Neighbor Distance of middens and red squirrels on the monitored areas, 1995 and 1996.

	December 1995				December 1996			
	Middens		Squirrels		Middens		Squirrels	
Area/Habitat	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se	n	$\bar{x}$ ± se
TRC	54	53.6 ± 5.18[a]	35	54.2 ± 6.14[a]	34	54.7 ± 5.80[a]	17	79.9 ± 7.49[a]
TRN	28	46.8 ± 3.08[a]	15	54.6 ± 6.83[a]	33	45.9 ± 2.63[a,b]	15	51.3 ± 5.70[b]
SFC	119	44.1 ± 1.58[a]	105	46.7 ± 1.77[a]	113	43.3 ± 1.42[b]	55	51.9 ± 2.49[b]
SFN	113	52.4 ± 2.40[a]	82	58.9 ± 4.23[a]	121	48.5 ± 1.80[a,b]	60	72.8 ± 4.77[a]
TR Habitat	82	51.3 ± 3.57	50	54.3 ± 4.72	67	50.4 ± 3.24	32	66.5 ± 5.37
SF Habitat	232	48.2 ± 1.44	187	52.0 ± 2.14	234	46.0 ± 1.17	115	62.8 ± 2.91
TOTAL	314	49.0 ± 1.42	237	52.5 ± 1.96	301	47.0 ± 1.16	147	63.6 ± 2.56

ANOVA:	**1995**			**1996**		
NND of Middens						
among all areas	F=2.94	df=3	***P=0.0333***	F=3.26	df=3	***P=0.0219***
NND of Squirrels						
among all areas	F=2.64	df=3	***P=0.0502***	F=7.61	df=3	***P=0.0001***

[a,b,c] Means with the same letter(s) are not significantly different. In some cases a difference between means is seen using ANOVA, but no difference is seen in the multiple range test (a,b) because the variance of the samples is too large.

Figure 1. Map of the areas monitored by the University of Arizona Red Squirrel Monitoring Program, December 1996.

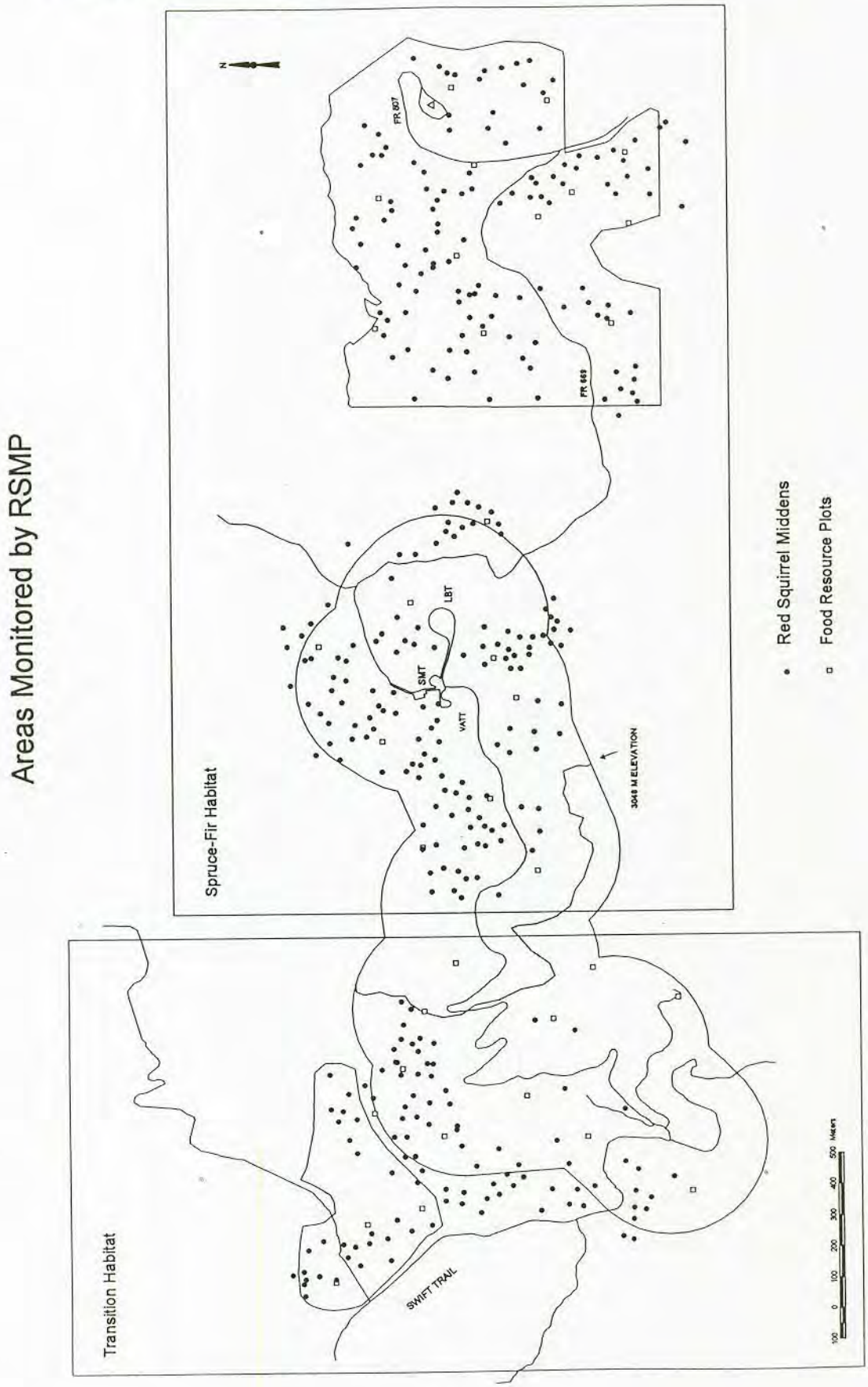


Figure 2. Map showing intensely burned portions of the monitored areas.

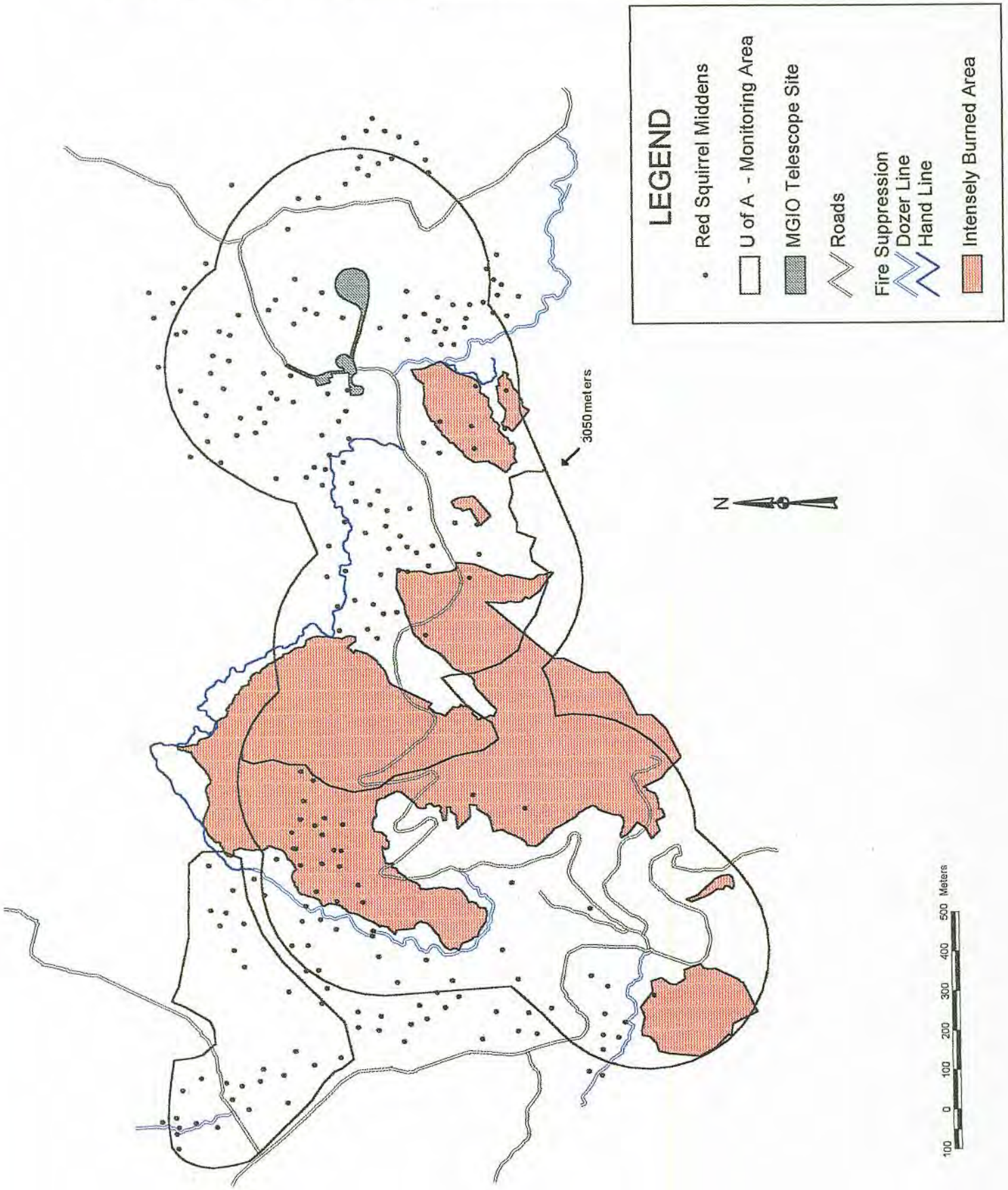


Figure 3a. Engelmann spruce seed fall, 1993-1995. Note: scales are different for figures 3a-c.

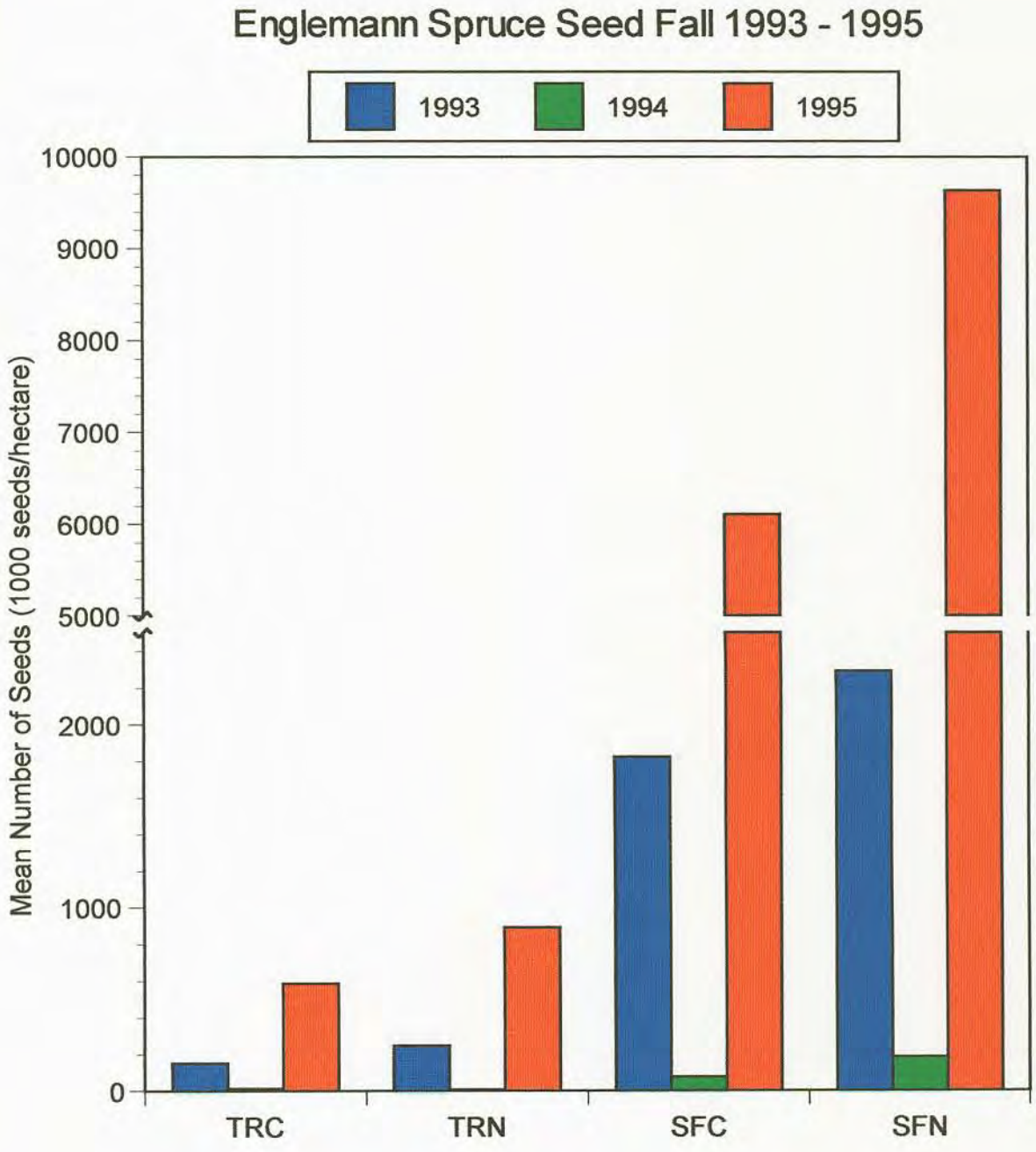


Figure 3b. Corkbark fir seed fall, 1993-1995. Note: scales are different for figures 3a-c.

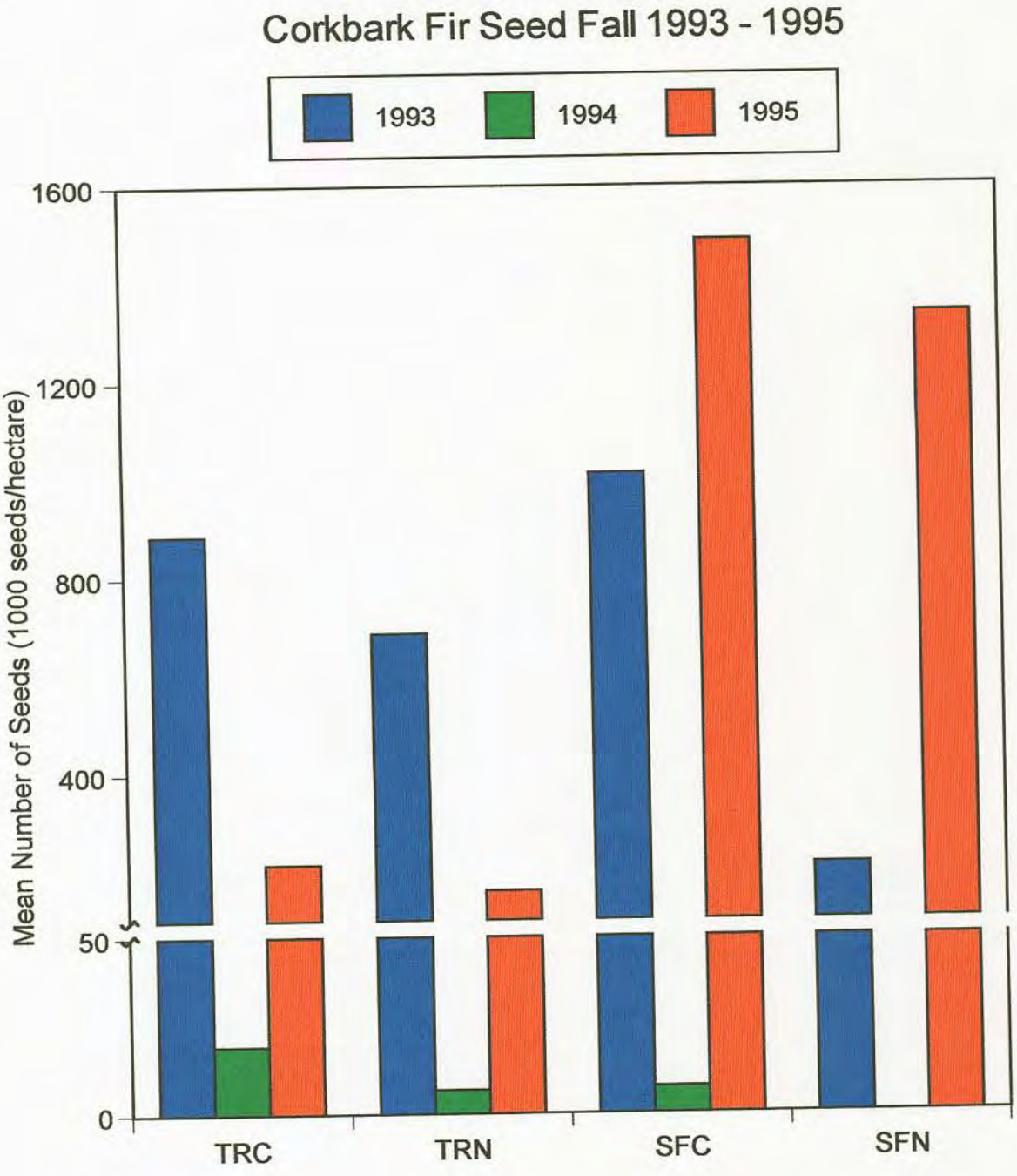


Figure 3c. Douglas-fir seed fall, 1993-1995. Note: scales are different for figures 3a-c.

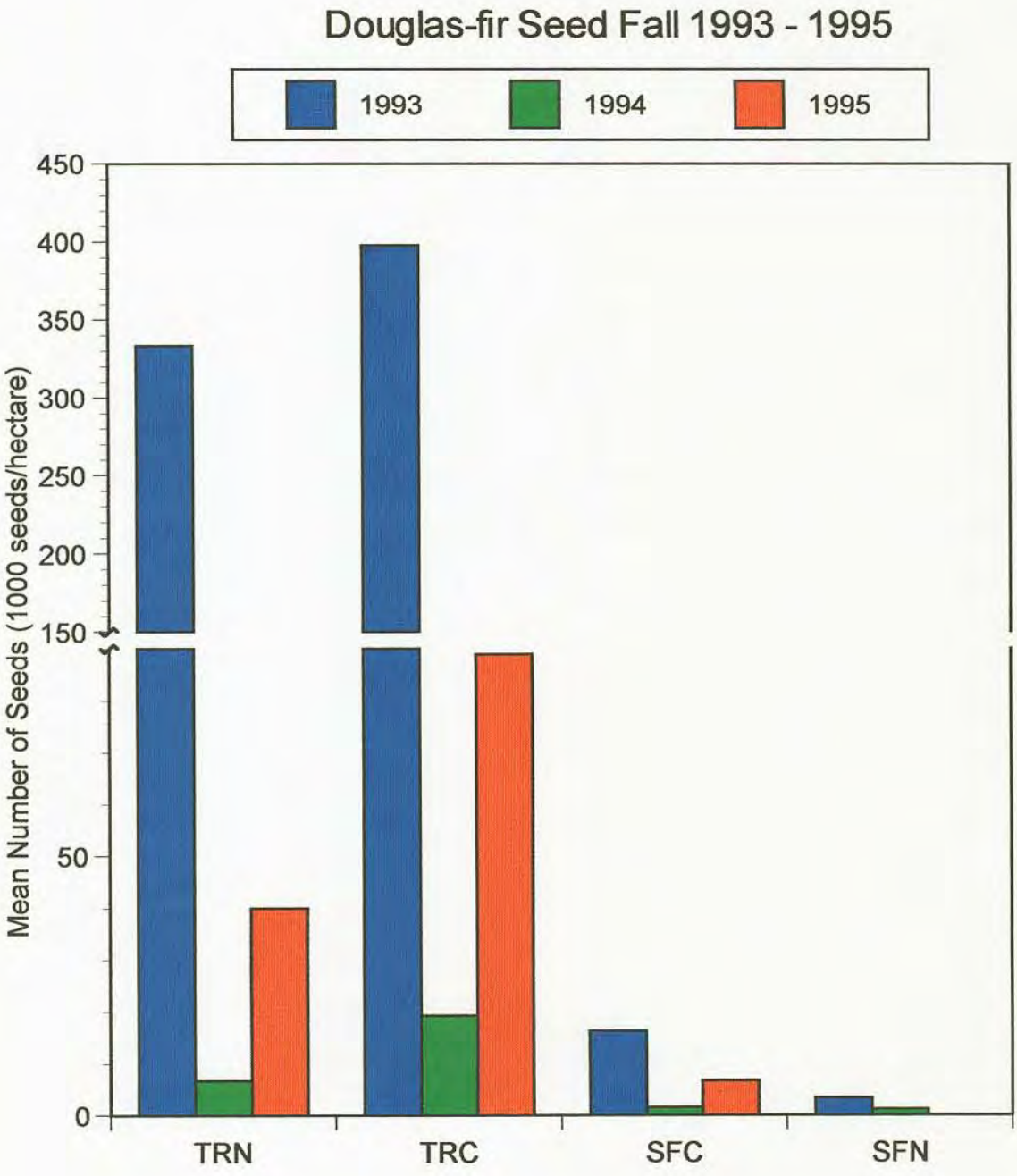


Figure 4a. Mushroom crops, 1994-1996. (unburned transects only)

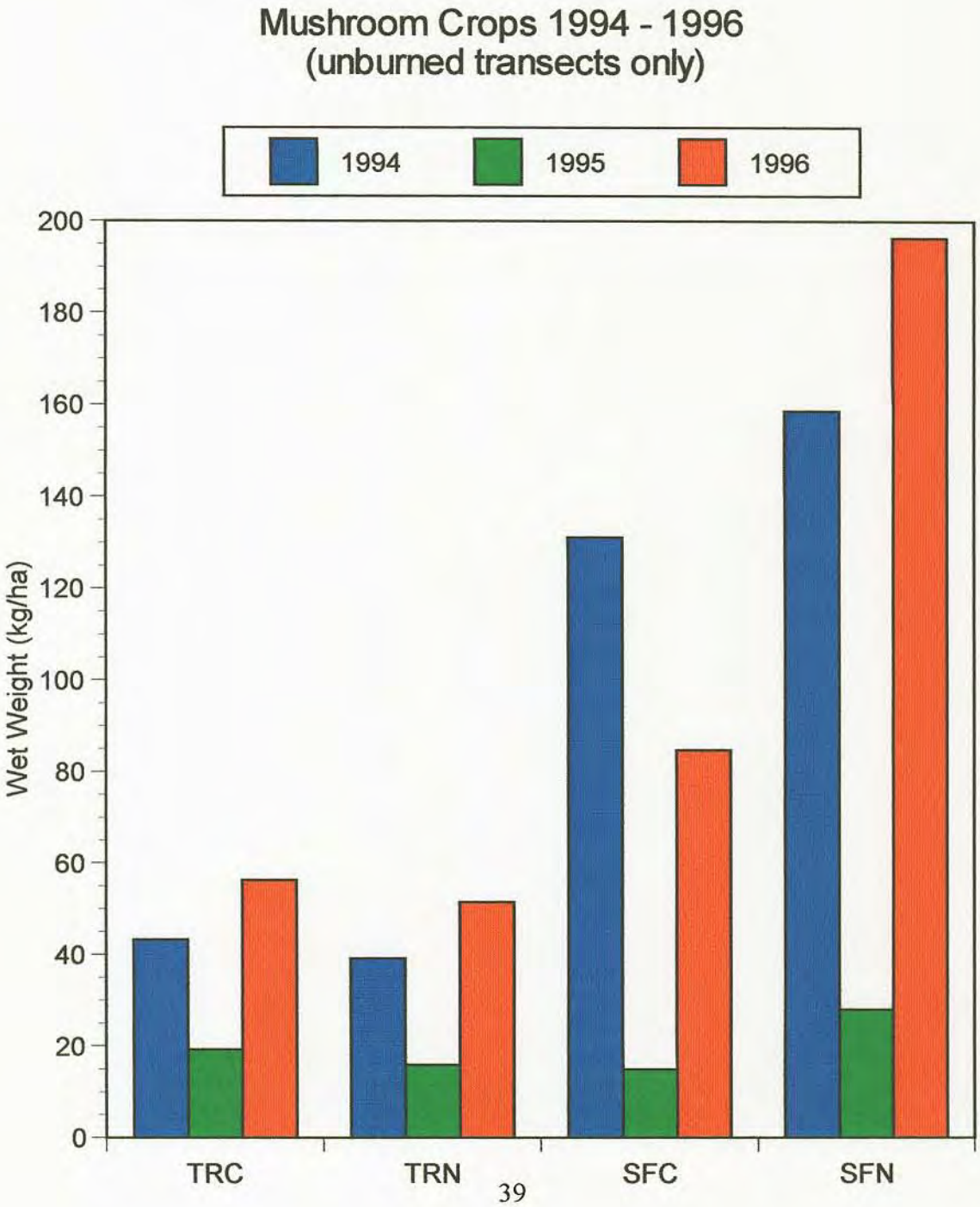


Figure 4b. Mushroom crops, 1994-1996. (all transects)

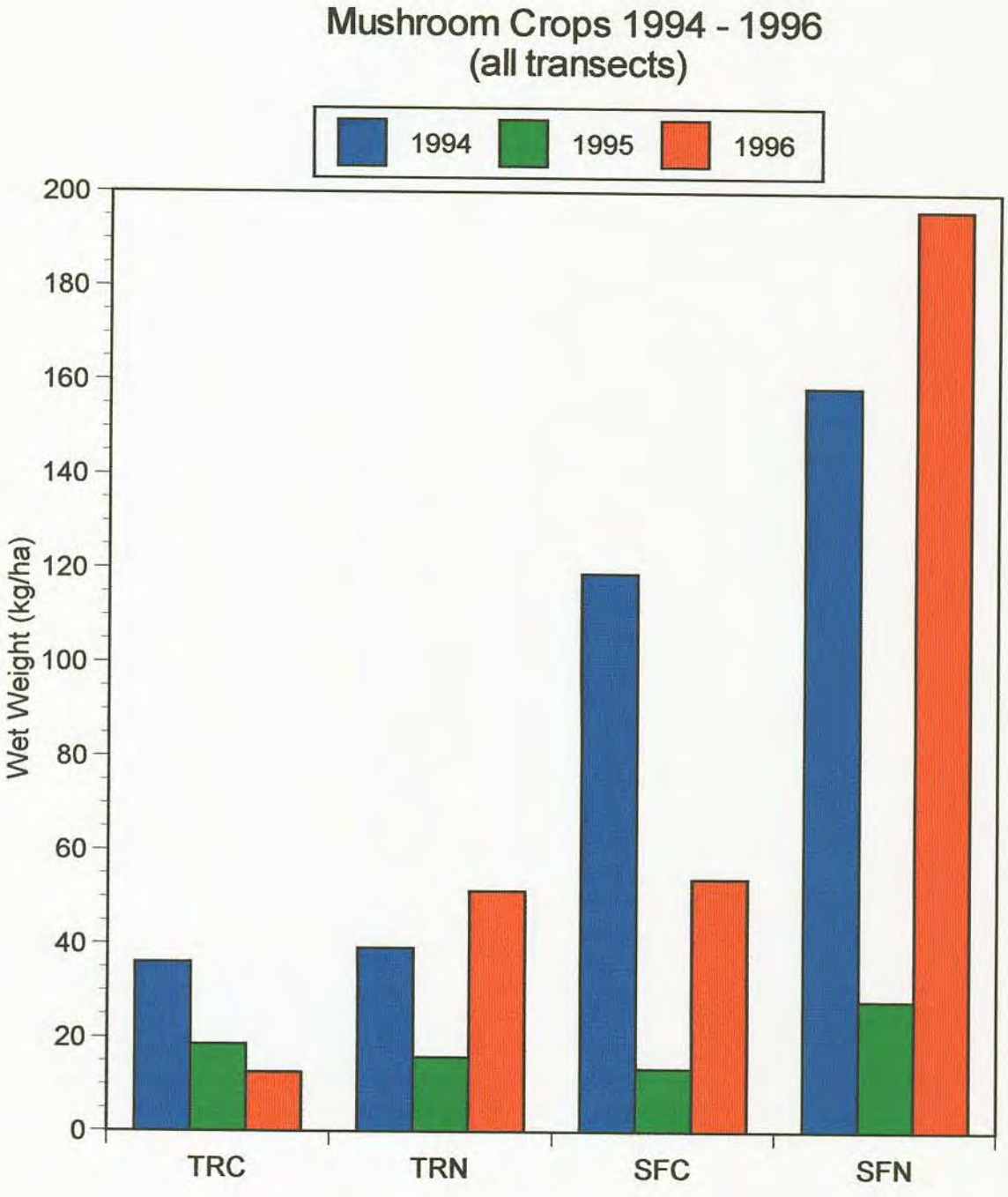


Figure 5. Energy availablity on the monitored areas, 1994-1995.

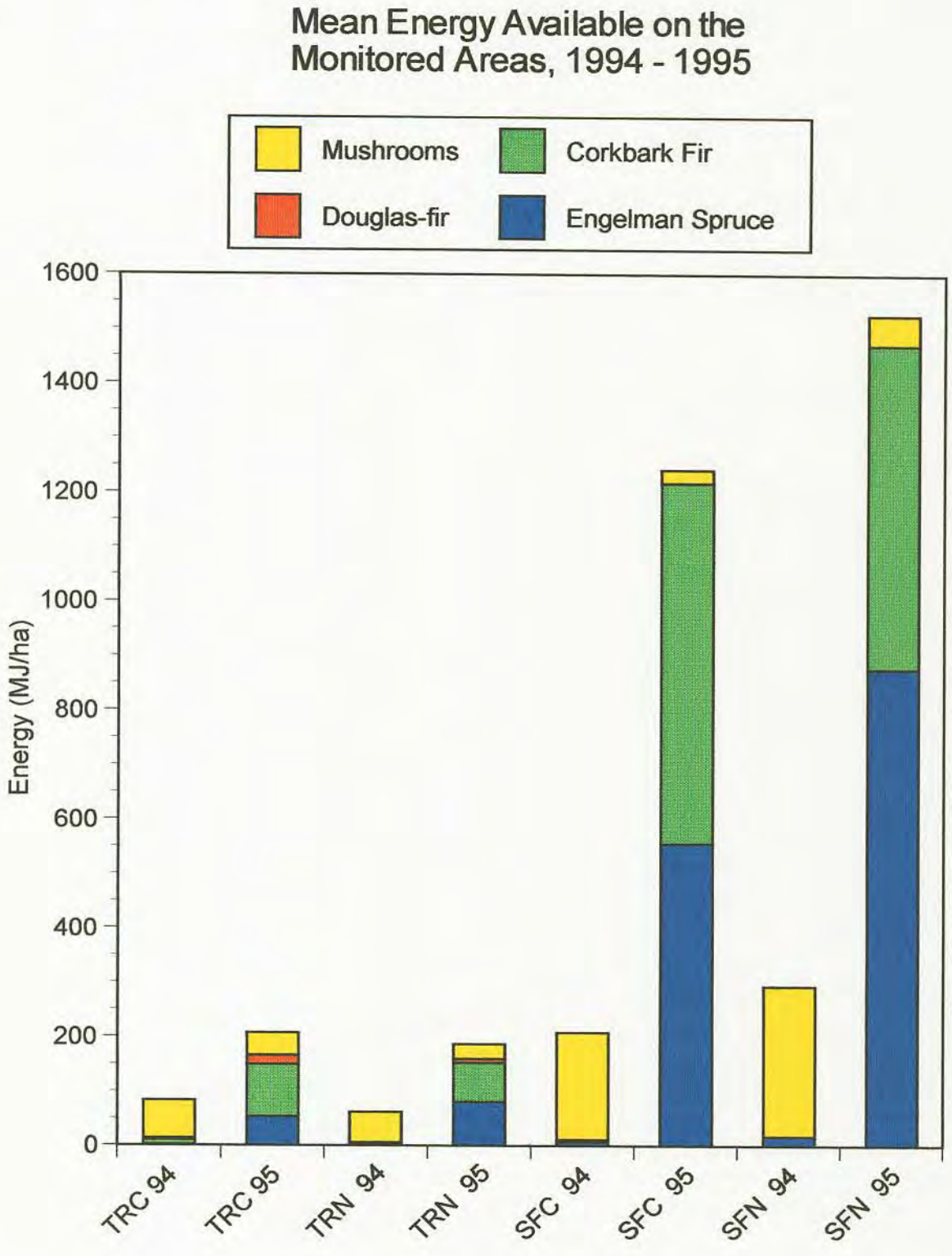


Figure 6. Distribution of total available energy from selected red squirrel food resources, 1995.

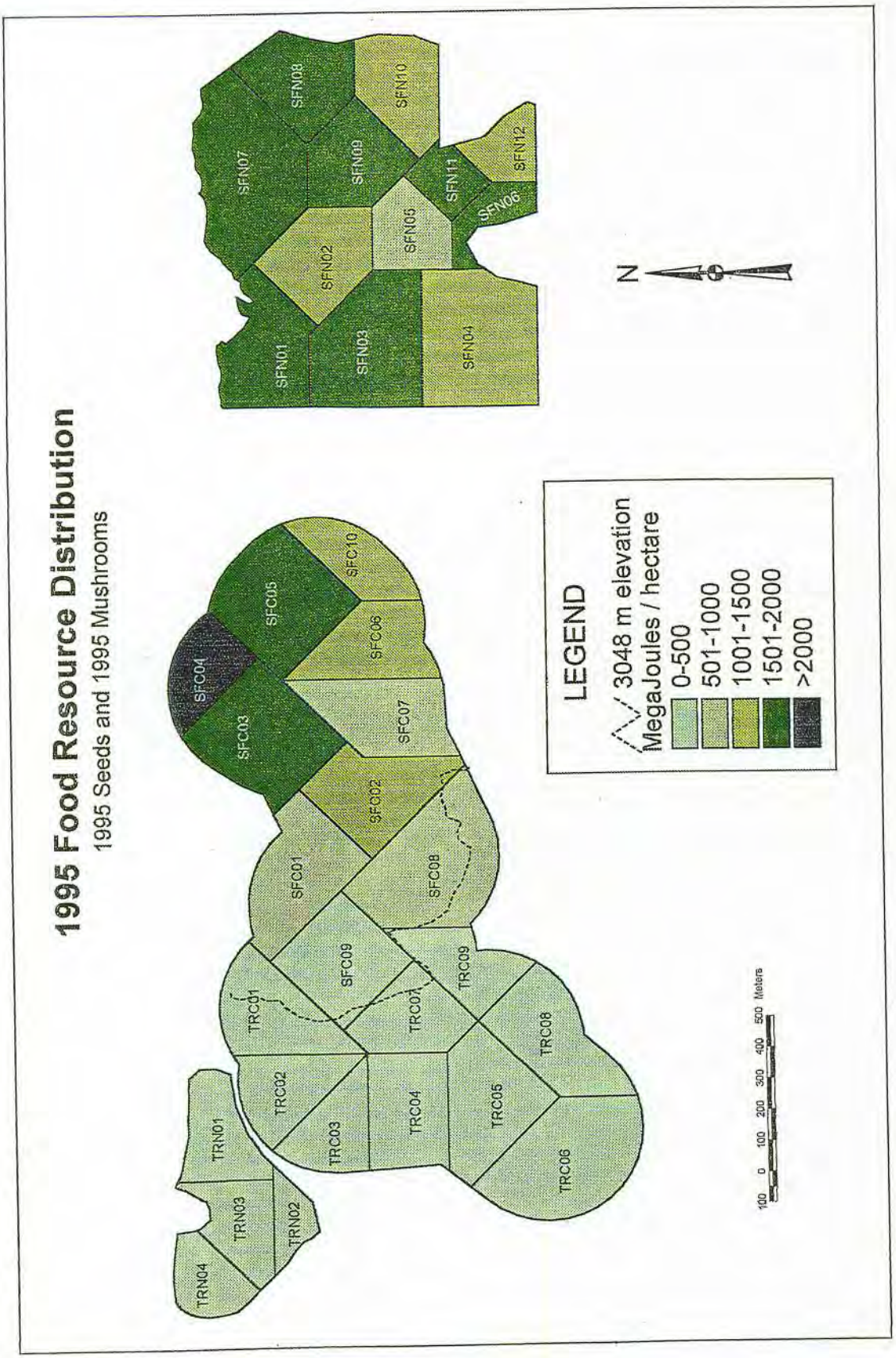


Figure 7. Red squirrel populations (including juveniles) on the monitored areas, December 1995 - December 1996.

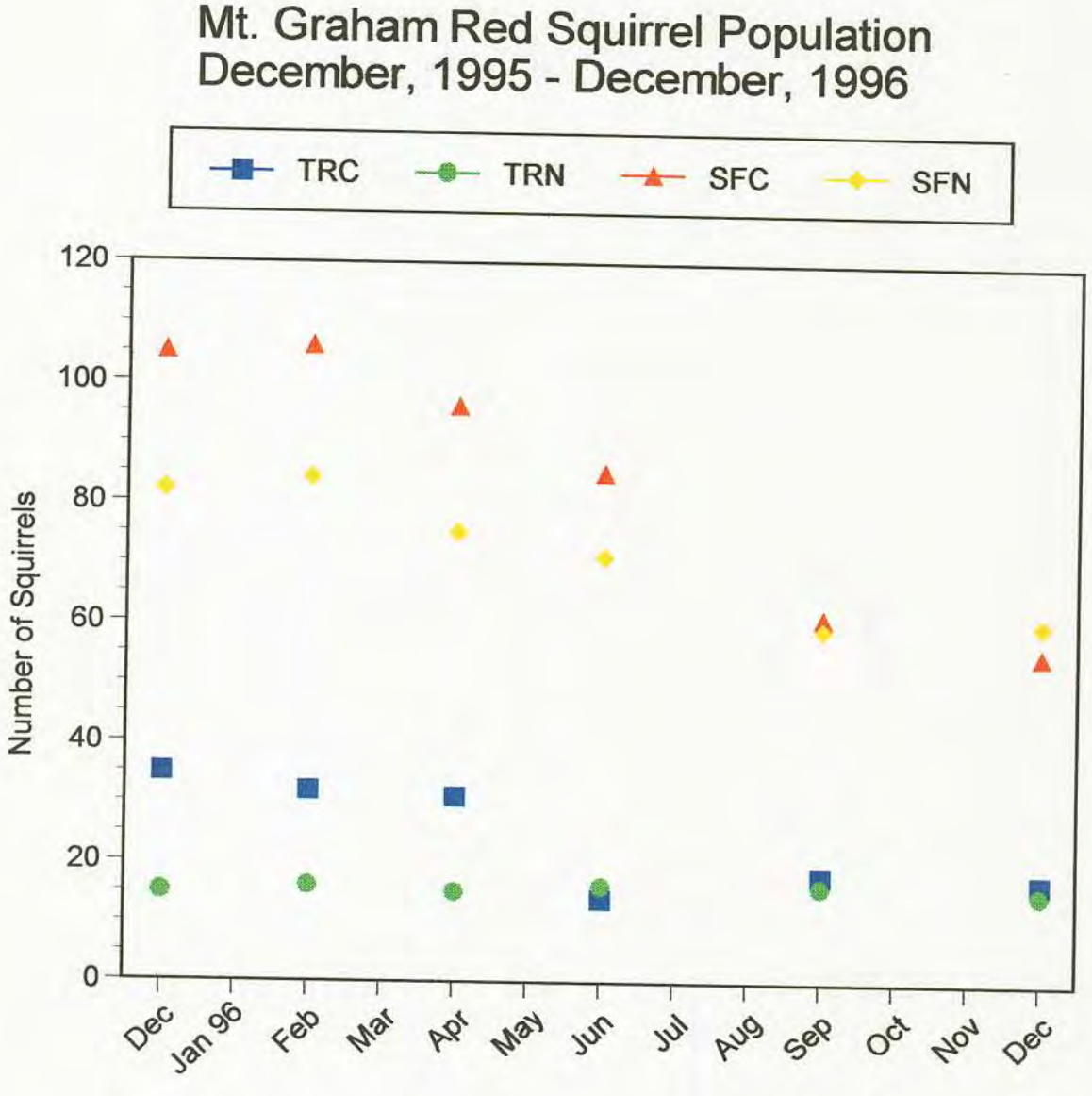


Figure 8. Crude density of middens and squirrels, 1995-1996.

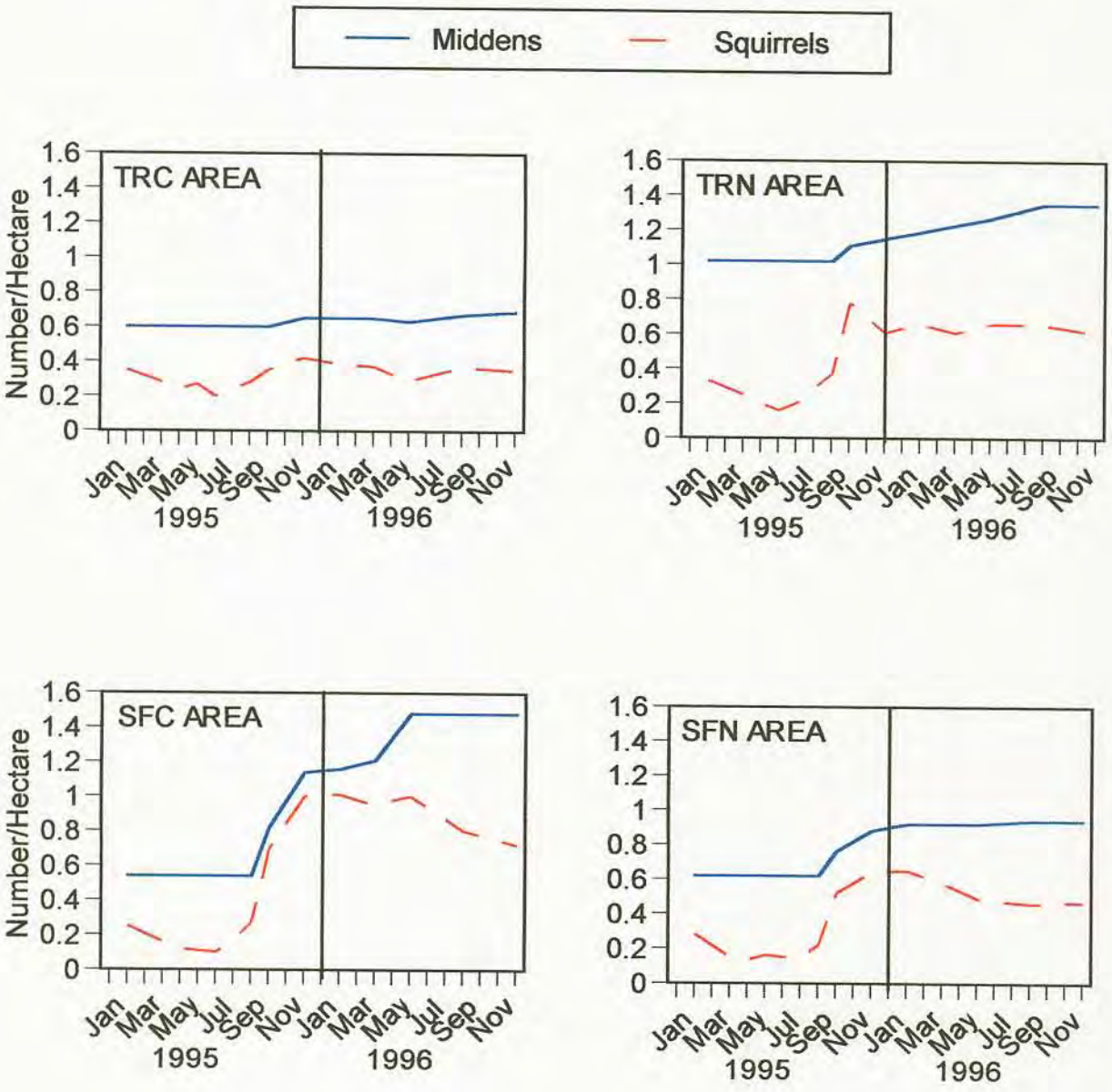


Figure 9. Local density of middens and squirrels, 1995-1996.

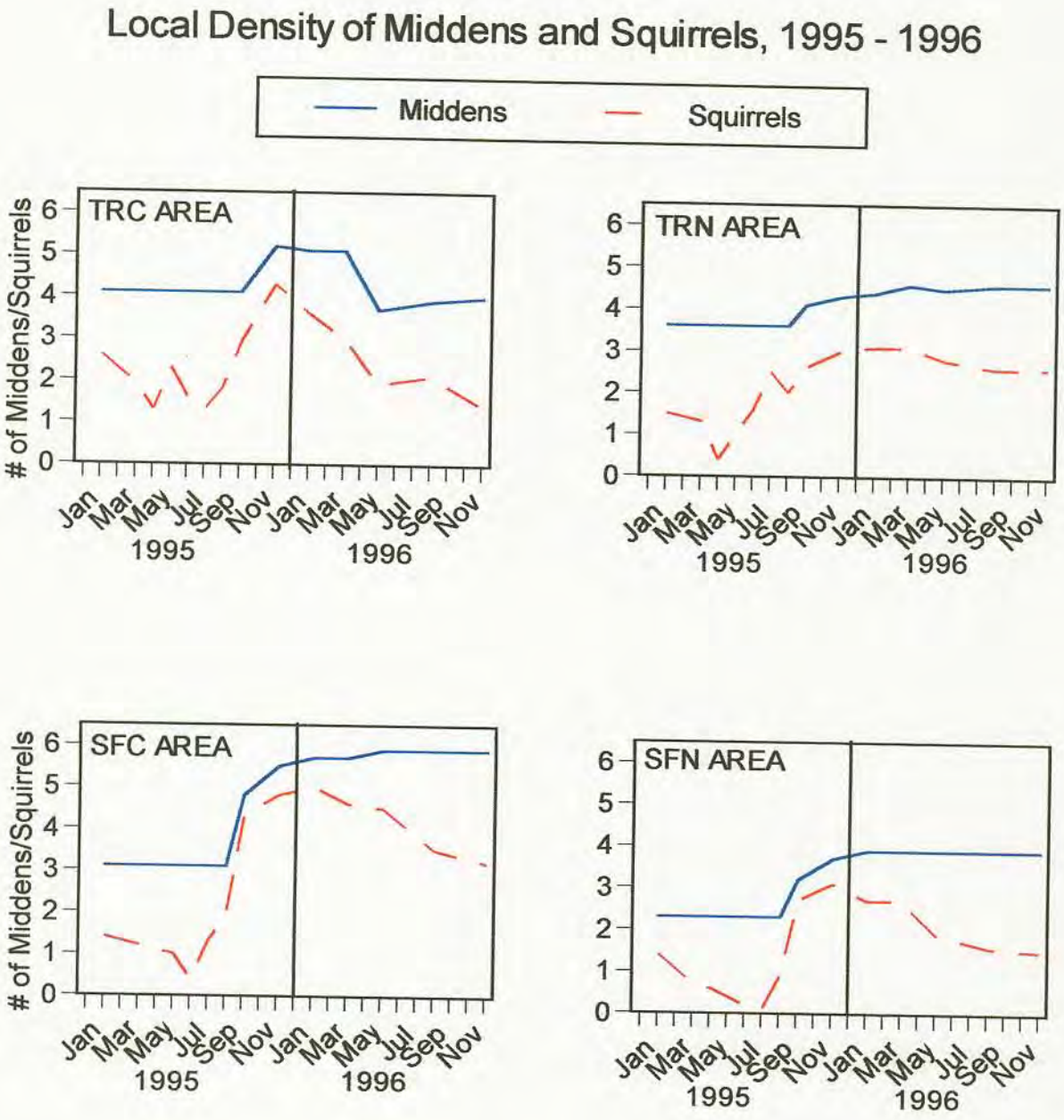


Figure 10. Nearest neighbor distance of middens and squirrels, 1995-1996.

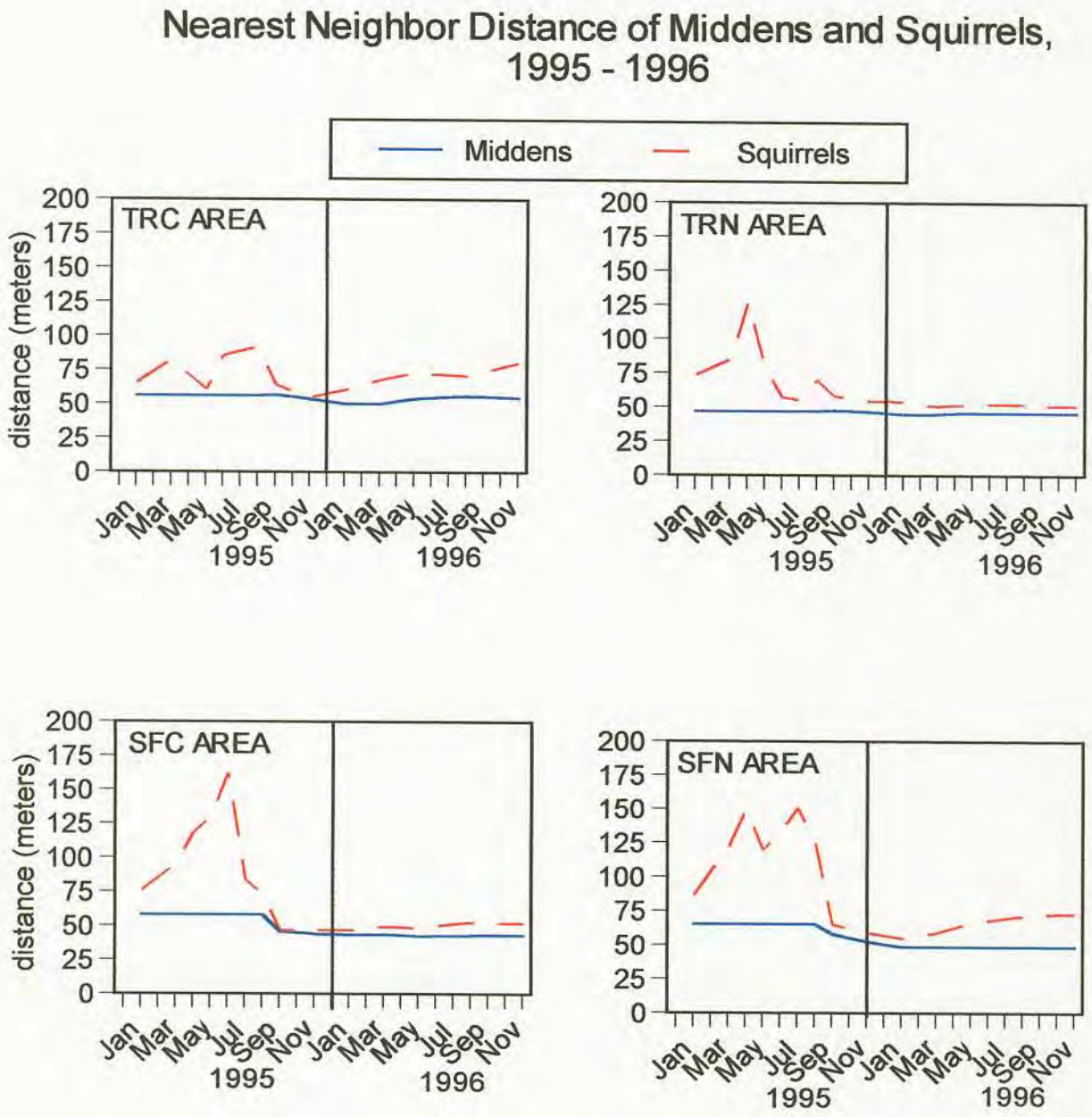


Figure 11. Monthly temperatures on the monitored areas, 1996.

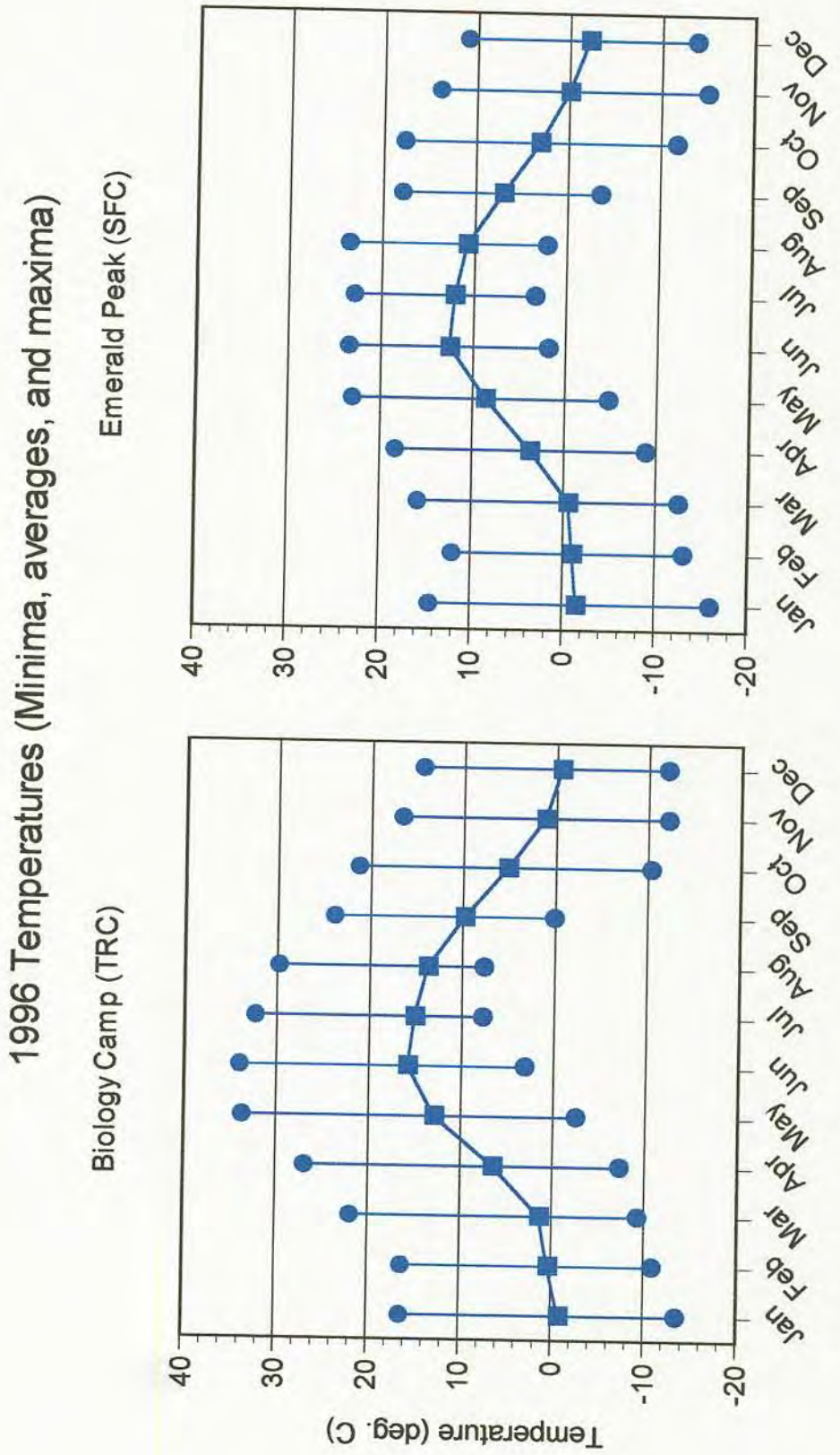


Figure 12. Total monthly precipitation as rain, 1996.

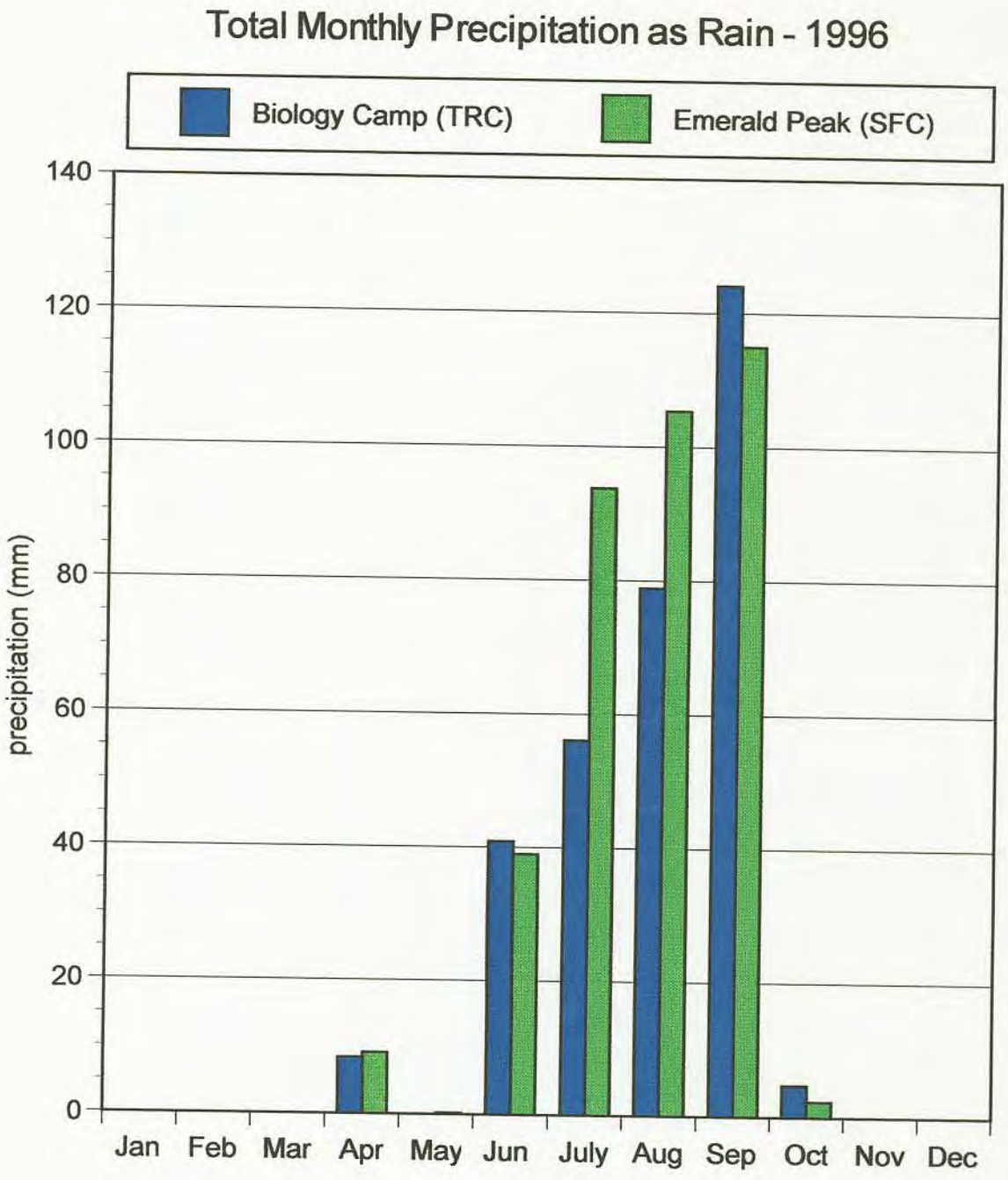
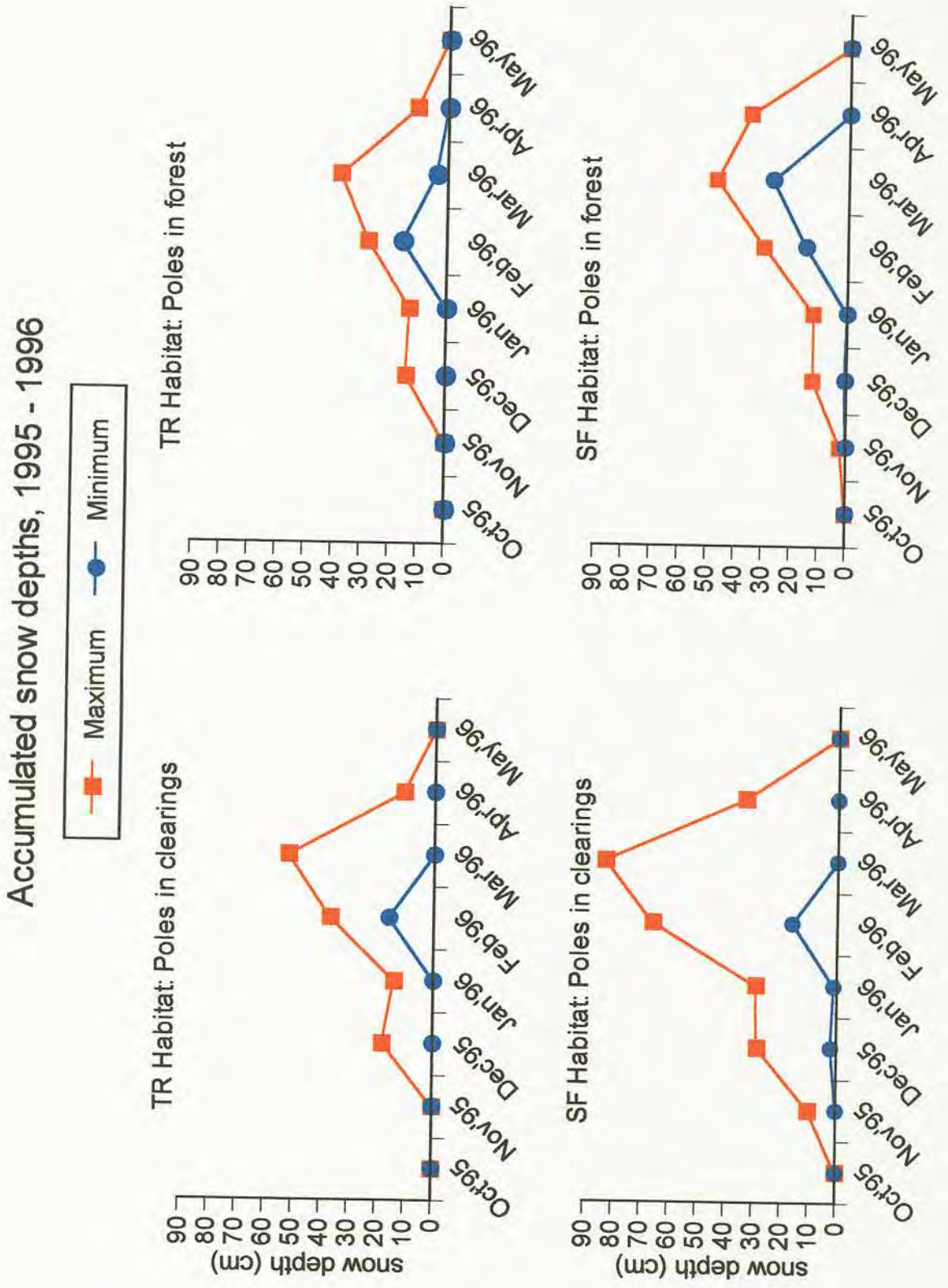


Figure 13. Accumulated snow depths, 1995-1996.



Appendix A. Energy potentially available (1995) from four resources on each of the sampling transects on the monitored areas. 50
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Appendix A. Energy potentially available (1995) from four resources on each of the sampling transects on the monitored areas. (All transects.)

		Englemann Spruce		Corkbark Fir		Douglas-fir		Total Seeds		Total Mushrooms			Total Energy
AREA	TRAN	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	ww Kg/ha	dw Kg/ha	MJ/ha	MJ/ha
TRC	1	360.0	32.8	813.3	361.1	133.3	25.6	1306.7	419.5	19.82	2.68	48.2	467.7
	2	93.3	8.5	400.0	177.6	253.3	48.6	746.7	234.7	47.27	5.04	90.7	325.5
	3	293.3	26.7	333.3	148.0	173.3	33.3	800.0	208.0	20.78	3.16	56.9	264.9
	4	2186.7	199.0	53.3	23.7	26.7	5.1	2266.7	227.8	4.49	0.37	6.7	234.4
	5	213.3	19.4	186.7	82.9	0.0	0.0	400.0	102.3	17.76	1.80	32.4	134.7
	6	40.0	3.6	0.0	0.0	0.0	0.0	40.0	3.6	40.22	5.25	94.5	98.1
	7	973.3	88.6	146.7	65.1	160.0	30.7	1280.0	184.4	5.63	0.78	14.0	198.5
	8	720.0	65.5	0.0	0.0	13.3	2.6	733.3	68.1	0.00	0.00	0.0	68.1
	9	400.0	36.4	0.0	0.0	40.0	7.7	440.0	44.1	11.40	1.60	28.8	72.9
TRN	1	146.7	13.3	186.7	82.9	13.3	2.6	346.7	98.8	6.49	0.67	12.1	110.8
	2	1440.0	131.0	200.0	88.8	146.7	28.2	1786.7	248.0	7.15	0.85	15.3	263.3
	3	280.0	25.5	200.0	88.8	0.0	0.0	480.0	114.3	30.79	1.89	34.0	148.3
	4	1693.3	154.1	53.3	23.7	0.0	0.0	1746.7	177.8	19.15	2.60	46.8	224.6

Appendix A: (cont.)

		Englemann Spruce		Corkbark Fir		Douglas-fir		Total Seeds		Total Mushrooms			Total Energy
AREA	TRAN	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	ww Kg/ha	dw Kg/ha	MJ/ha	MJ/ha
SFC	1	1746.7	158.9	1640.0	728.2	0.0	0.0	3386.7	887.1	23.24	1.73	31.1	918.2
	2	12666.7	1152.7	0.0	0.0	0.0	0.0	12666.7	1152.7	7.23	1.05	18.9	1171.6
	3	7813.3	711.0	1840.0	817.0	0.0	0.0	9653.3	1528.0	9.50	0.88	15.8	1543.8
	4	6613.3	601.8	3560.0	1580.6	0.0	0.0	10173.3	2182.5	11.86	0.93	16.7	2199.2
	5	2186.7	199.0	3866.7	1716.8	0.0	0.0	6053.3	1915.8	11.43	1.09	19.6	1935.4
	6	5133.3	467.1	2106.7	935.4	0.0	0.0	7240.0	1402.5	16.97	2.16	38.9	1441.4
	7	6426.7	584.8	866.7	384.8	26.7	5.1	7320.0	974.7	18.21	1.22	22.0	996.7
	8	9386.7	854.2	13.3	5.9	26.7	5.1	9426.7	865.2	14.67	1.26	22.7	887.9
	9	1226.7	111.6	240.0	106.6	0.0	0.0	1466.7	218.2	5.78	0.59	10.6	228.8
	10	7866.7	715.9	760.0	337.4	13.3	2.6	8640.0	1055.9	16.33	2.19	39.4	1095.3

Appendix A: (cont.)

		Englemann Spruce		Corkbark Fir		Douglas-fir		Total Seeds		Total Mushrooms			Total Energy
AREA	TRAN	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	# 1000 seeds/ha	MJ/ha	ww Kg/ha	dw Kg/ha	MJ/ha	MJ/ha
SFN	1	6320.0	575.1	2413.3	1071.5	0.0	0.0	8733.3	1646.6	52.96	4.53	81.5	1728.2
	2	7386.7	672.2	920.0	408.5	0.0	0.0	8306.7	1080.7	50.60	5.46	98.3	1179.0
	3	2626.7	239.0	3706.7	1645.8	0.0	0.0	6333.3	1884.8	32.64	3.23	58.1	1942.9
	4	11120.0	1011.9	13.3	5.9	0.0	0.0	11133.3	1017.8	5.45	0.85	15.3	1033.1
	5	9706.7	883.3	0.0	0.0	0.0	0.0	9706.7	883.3	22.98	2.67	48.1	931.4
	6	17066.7	1553.1	13.3	5.9	0.0	0.0	17080.0	1559.0	7.26	1.82	32.8	1591.8
	7	3466.7	315.5	2946.7	1308.3	0.0	0.0	6413.3	1623.8	20.68	1.72	31.0	1654.8
	8	6653.3	605.5	2613.3	1160.3	0.0	0.0	9266.7	1765.8	28.78	3.11	56.0	1821.8
	9	6840.0	622.4	1960.0	870.2	0.0	0.0	8800.0	1492.7	14.02	1.18	21.2	1513.9
	10	10133.3	922.1	1146.7	509.1	0.0	0.0	11280.0	1431.3	37.74	3.68	66.2	1497.5
	11	20653.3	1879.5	66.7	29.6	0.0	0.0	20720.0	1909.1	25.88	4.13	74.3	1983.4
	12	13626.7	1240.0	266.7	118.4	0.0	0.0	13893.3	1358.4	36.36	4.26	76.7	1435.1
TRC $\bar{x}$	9	586.7	53.4	214.8	95.4	88.9	17.1	890.4	165.8	18.60	2.30	44.4	207.2
TRN $\bar{x}$	4	890.0	81.0	160.0	71.0	40.0	7.7	1090.0	159.7	15.90	1.50	27.0	186.8
SFC $\bar{x}$	10	6106.7	555.7	1489.3	661.3	6.7	1.3	7602.7	1218.3	13.52	1.31	23.6	1241.8
SFN $\bar{x}$	12	9633.3	876.6	1338.9	594.5	0.0	0.0	10972.2	1471.1	27.95	3.05	55.0	1526.1
TR $\bar{x}$	13	680.0	61.9	197.9	87.9	73.8	14.2	951.8	163.9	17.77	2.05	37.0	200.9
SF $\bar{x}$	22	8030.3	730.8	1407.3	624.8	3.0	0.6	9440.6	1356.2	21.39	2.26	40.7	1396.9

Appendix B: Midden occupancy maps, 1996.

Appendix C: Red squirrel populations (including juveniles) on the areas being monitored by the Red Squirrel Monitoring Program, from December 1995 through December 1996.

Date	TRC	TRN	SFC	SFN	TOTAL
Dec 1995	35	15	105	82	237
Jan 1996	-	-	-	-	-
Feb 1996	32	16	106	84	238
Mar 1996	-	-	-	-	-
Apr 1996	30	15	96	75	216
May 1996	-	-	-	-	-
June 1996	14	16	76+9	63+8	169+17
July 1996	-	-	-	-	-
Aug 1996	-	-	-	-	-
Sep 1996	18	16	61	59	154
Oct 1996	-	-	-	-	-
Nov 1996	-	-	-	-	-
Dec 1996	17	15	55	60	147

- No data- census not conducted.

Appendix D: Occupancy records of middens on the monitored areas during 1996.

KEY

For Midden Numbers:

###[89*] Midden Number['Year Found' '*' following year indicates a newly established midden

For Monthly Occupancy cells:

N	Not Occupied
P	Possibly Occupied, Red Squirrel sign found but unsure of residency
Y	Occupied, Red Squirrel sign indicates resident
S	Occupied, Red Squirrel sighted
♀	Occupied, Adult female Red Squirrel
♂	Occupied, Adult male Red Squirrel
J	Occupied, Juvenile Red Squirrel sex unknown
A	Abert's Squirrel using area, no Red Squirrel present
XX	Remains of Red Squirrel found
*	Squirrel is tagged
-	Midden not checked, no data
♀L	Adult female Red Squirrel, lactating
♀+'#'	Adult female Red Squirrel with "#" juveniles
RC	Radio-collared Red Squirrel (Arizona Game and Fish Study)
✖	Midden was destroyed in the Clark Peak Fire

Transition Construction Area (TRC) Midden Occupancy 1996												
Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[11]	Aug[11]	Sep	Oct[12]	Nov	Dec
1101[89]	-	♂	-	Y	-	♂	-	-	♂[4]	-	-	♂
1102[89]	-	N	-	N	-	N	-	-	N	-	-	N
1103[89]	-	♀	-	♀	-	S	-	-	♀	-	-	N
1104[89]	-	N	-	♂	-	N	N	-	N	-	-	N
1105[89]	-	♀	-	♂	-	N ✖	N					
1106[89]	-	S	-	Y	-	♂	♂	-	♂	-	-	S
1107[89]	-	N	-	N	-	N ✖						
1108[89]	-	♂	-	Y	-	P	S	-	N	-	-	N
1109[89]	-	♂	-	Y	-	N[6] ✖						
1110[89*]	Y	S	-	Y	-	N ✖						
1111[89]	-	N	-	N	-	N	-	-	N	-	-	N
1112[89*]	-	N	-	N	-	P	-	-	N	-	-	N
1113[89]	-	♀	-	Y	-	S	-	-	♀	-	-	♂
1114[89]	-	N	-	N	-	N	-	-	N	-	-	N
1115[89]	-	N	-	N	-	N	-	-	N	-	-	N
1116[89*]	♀[*2]	♀[*2]	P	S	-	♂	N	-	♂	-	-	Y
1117[89]	-	N	-	N	-	N ✖						
1118[89]	-	♀	-	♀	-	S	-	-	♂	-	-	S
1119[88]	-	♀[4]	-	♀	-	N[6] ✖	N					
1120[89]	-	♂	-	Y	-	N ✖						
1121[89*]	-	♂	-	Y	-	♂	♂	S	♂	-	-	S
1122[89]	-	N	-	N	-	N ✖						
1123[95*]	-	Y	-	P	-	N ✖						
1124[95*]	-	Y	-	N	-	N ✖						
1125[95*]	-	N	-	N	-	N ✖						
1126[95*]	-	♂	-	P	-	N	-	-	N	-	-	N
1130[90]	-	♂[4]	-	♂	-	N ✖						
1131[90*]	-	♀[4]	-	♀	-	♂	-	-	♂[10]	-	-	♂
1132[90*]	-	N	-	N	-	N	N	-	N[10]	-	-	N
1134[91*]	-	N	-	N	-	N	-	-	N	N	-	N
1135[91*]	-	♂	-	♂	-	♂[7] ✖	♂[7]					
1136[91*]	-	N	-	N	-	N ✖						
1137[91*]	-	♀	-	Y	-	N ✖						
1138[91*]	-	N	-	N	-	N	-	-	N	-	-	P
1139[91*]	♀[*3]	♀[*3]	Y	Y	-	N ✖						
1140[91*]	-	N	-	N	-	N ✖						

Transition Construction Area (TRC) Midden Occupancy 1996												
Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[11]	Aug[11]	Sep	Oct[12]	Nov	Dec
1141[91*]	-	♀	-	♀	-	N ✖						
1142[91*]	-	♂	-	Y	-	N ✖						
1143[91*]	-	♀	-	♀L+1[5]	-	N ✖						
1144[91*]	-	♀	-	S	-	♀L/♂[8]	♂	-	♀	-	-	S
1145[91*]	-	P	-	N	-	N	-	-	N	-	-	N
1146[91*]	-	N	-	N	-	N	-	-	N	-	-	N
1147[91*]	-	♂	-	♂	-	♂	-	-	♂	-	-	♂
1148[91*]	-	♂	-	Y	-	N ✖						
1149[91*]	-	♀	-	Y	-	♀	♀	-	♀	-	-	S
1150[91*]	-	N	-	N	-	N	-	-	♂	-	-	♂
1151[91*]	-	N	-	N	-	N	-	-	N	-	-	N
1152[91*]	-	♀	-	♀L	-	N[9] ✖						
1153[92*]	-	N	-	N	-	N	-	-	N	-	-	N
1154[92*]	-	S	-	Y	-	♂	-	-	♀	-	-	♀
1155[93*]	-	N	-	N	-	N	-	-	♂	-	-	♂
1156[93*]	-	N	-	N	-	N	-	-	♀	-	-	S
1157[93*]	-	♂	-	S	-	♂	-	-	♂	-	-	S
1159[93*]	Y	♂	-	♂	-	N[6] ✖						
1160[96*]	new								♀	♀	-	♀
1161[96*]	new								S	-	-	N
1162[96*]	new											S
# Mid	-	54	-	54	-	**31**[13]	-	-	33	-	-	34
# Occ	-	32	-	30	-	14[13]	-	-	18	-	-	17
% Occ	-	59	-	56	-	45	-	-	55	-	-	50
# Sq	-	32	-	30+1	-	14[13]	-	-	18	-	-	17

[1] A full census was not conducted. Middens where marked squirrels were seen in the previous quarter were checked. In addition, other middens near the marked squirrels may have been checked.

[2] Marked female Y/O.

[3] Marked female G/- (G/G).

[4] Squirrel has a natural identifying mark such as an ear notch, short tail, etc.

[5] A lactating ♀ was seen carrying a small pink baby to a ground nest near the plaque tree.

TRC (cont.):

[6] This midden was completely burned in the Clark Peak fire. Some feeding sign was located in the midden, but no red squirrel was seen.

[7] This midden was completely burned in the Clark Peak fire. A male red squirrel has been seen in the midden several times. This red squirrel has been seen going to and from the unburned area about 35m to the west. It was unclear whether this male was still residing in this midden or just feeding in the area. After July 1996, there was no further activity at this midden.

[8] Both a ♀L and a ♂ were seen in this midden at different times during the month. It was unclear which squirrel was the resident.

[9] This midden was completely burned in the Clark Peak fire. A ♀ red squirrel was seen in the midden several times in early June. She appeared to be still living in the midden and was using a ground nest under a rock. This female was not seen after 14 June.

[10] The ♂ from midden 1131 has been observed using midden 1132 as well.

[11] A complete census was not conducted in July and August, but several middens were checked during other monitoring activities.

[12] Only middens within approximately 100m of construction or the access road were censused.

[13] The number of middens in June does not include midden 1135 which was completely burned in the Clark Peak Fire. However, the number of squirrels for June does include the male seen several times in midden 1135 (see also footnote #7).

Transition Non-construction Area (TRN) Midden Occupancy 1996												
Midden	Jan	Feb	Mar	Apr	May	June	July[5]	Aug[5]	Sep	Oct	Nov	Dec
2201[89]	-	♂	-	♂	-	♂	-	-	♂	-	-	♂
2202[89]	-	♀	-	♀	-	♀	-	-	♀	-	-	♀
2203[89]	-	♂	-	♂	-	♂	-	-	♂[3]	-	-	S
2204[89]	-	N	-	N	-	N	-	-	N	-	-	N
2205[89]	-	♂	-	♀	-	♀	-	-	S	-	-	S
2206[89]	-	S	-	Y	-	♂	♂	-	S	-	-	S
2207[89*]	-	N	-	N	-	N	-	-	N	-	-	N
2208[89*]	-	♀[1]	-	P	-	♂	-	-	♂[1]	-	-	S
2209[89]	-	N	-	N	-	N	-	-	N	-	-	N
2210[90]	-	♂	-	Y	-	♂	-	-	S	-	-	S
2211[90*]	-	♀	-	♀	-	S	♀	-	♀	-	-	♀
2212[90]	-	♀[2]	-	♀[2]	-	♀[2]	-	-	♀[2]	-	-	♀
2213[90]	-	N	-	N	-	N	-	-	N	-	-	N
2214[90*]	-	Y	-	Y	-	♀L	-	-	♀	-	-	XXX[6]
2215[90*]	-	♂	-	Y	-	N	-	-	N	-	-	N
2216[90*]	-	N	-	N	-	N	-	-	N	-	-	N
2217[90*]	-	♀	-	♀	-	♂	-	-	N[3]	-	-	N
2218[91*]	-	N	-	N	-	N	-	-	N	-	-	N
2219[91*]	-	N	-	N	-	N	-	-	N	-	-	N
2220[91*]	-	N	-	N	-	N	-	-	N	-	-	N
2221[91*]	-	N	-	N	-	N	-	-	N	-	-	N
2222[91*]	-	N	-	N	-	N	-	-	N	-	-	N
2223[91*]	-	N[2]	-	N[2]	-	N[2]	-	-	N[2]	-	-	♀
2224[93*]	-	N	-	N	-	N	-	-	N	-	-	N
2225[94*]	-	N	-	N	-	N	-	-	N	-	-	N
2226[95*]	-	♀	-	Y	-	♀	-	-	♀[4]	-	-	♀
2227[95*]	-	♂	-	Y	-	N	♂	-	N	-	-	N
2228[95*]	-	♂	-	♂	-	♀	-	-	N[4]	-	-	N
2229[96*]	new	♀	-	P	-	♀L	-	-	♀	-	-	♀
2230[96*]	new			♂		♂	-	-	♂	-	-	♀
2231[96*]	prob. est. in Fall/Winter 95-96, but recently discovered					♀L	-	-	♀	-	-	S
2232[96*]	new								♀	-	-	S
2233[96*]	new								S	-	-	N
# Mid	-	29	-	30	-	31	-	-	33	-	-	33
# Occ	-	16	-	15	-	16	-	-	16	-	-	15
% Occ	-	55	-	50	-	52	-	-	48	-	-	45
# Sq	-	16	-	15	-	16	-	-	16	-	-	15

TRN (cont.)

[1] Squirrel has a natural identifying mark such as an ear notch, short tail, etc.

[2] The ♀ from midden 2212 appears to be using midden 2223 also.

[3] The ♂ from midden 2203 appears to be using midden 2217 also.

[4] The ♀ from midden 2226 and ♂ from midden 5200 may be using midden 2228.

[5] A complete census was not conducted in July and August, but several middens were checked during other monitoring activities.

[6] Fresh blood and red squirrel fur were found on the snow and a wing print was also found near the kill site.

Spruce-Fir Construction Area (SFC) Midden Occupancy 1996												
Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[27]	Aug[27]	Sep	Oct[29]	Nov	Dec
3000[95*]	-	N[8]	-	♂	-	N	-	-	N	-	-	N
3001[95*]	-	♂	-	S	-	♂	-	-	S	-	-	S
3002[95*]	-	♂	-	P	-	N	-	-	♂	-	-	♂
3003[95*]	-	♂	-	N	-	N	-	N	N	N	-	N
3004[95*]	-	♀	-	♀	-	N ✖						
3005[95*]	-	♂	-	Y	-	Y	-	♀	N[21]	-	-	N
3006[95*]	-	♂	-	♀	-	♂	S	♂	N	-	-	N
3007[95*]	-	♂	-	Y	-	N	-	-	N	-	-	N
3008[95*]	-	♂	-	Y	-	♀L	-	-	S	-	-	N
3009[95*]	-	S	-	Y	-	N	-	-	S	-	-	P
3010[95*]	-	♂	Y	N	-	N	-	-	N	-	-	N
3011[95*]	-	S	-	♂	-	♂	-	-	♂[26]	-	-	S
3012[95*]	-	Y	-	♀	-	N ✖						
3013[95*]	-	♂	-	♀	-	Y	N	-	N	N	-	N
3014[95*]	-	♀	-	P	-	Y	N	-	N	N	-	N
3015[95*]	-	♀	-	S	-	N ✖						
3016[95*]	-	♂	-	Y	-	N ✖						
3017[95*]	-	S	-	Y	-	N ✖						
3018[95*]	-	♀	-	Y	-	N ✖						
3019[96*]	[new] S	♂	-	Y	-	N	-	♀	N	P	-	N
3020[96*]	new	S	-	Y	-	N[13]	-	♀[23]	♀[23]	♀	-	S
3021[96*]	new			S	-	N[14] ✖						
3022[96*]	prob. estab. in Fall/Winter 95-96, but recently discovered					♀L	-	-	N[22]	-	-	N
3300[86]	-	♀[9]	-	Y	-	♀+1	-	-	♀	-	-	♀
3301[94*]	-	N[9]	-	N	-	N	-	-	N	-	-	N
3302[94*]	-	N	-	N	-	N	S	-	N	-	-	N
3303[94*]	-	♀	-	Y	-	♀L	-	-	♀	-	-	♀
3304[94*]	-	N	-	N	-	N	-	-	N	-	-	N
3305[94*]	-	♀	-	♀	-	♀	-	-	♀	-	-	Y
3306[94*]	-	♂	-	♂	-	♂	-	♂	♂[21]	-	-	♂
3307[94*]	-	♀	-	♀	-	♀	-	N	♀	-	-	♀
3308[95*]	-	♀	-	♀	-	♂	S	-	S	-	-	N
3309[95*]	-	♂RC	Y	♂	-	♂RC	♂RC	♂RC	♂RC[22]	♂RC	-	♂RC[30]
3310[95*]	Y	♂[*10]	S	Y	-	N	-	-	N	-	-	N
3311[95*]	♂	♂	-	♂	-	♂	-	-	♂	-	-	S
3312[95*]	Y	Y	-	S	-	♀	-	-	♀	-	-	♀
3313[95*]	-	S	-	S	-	N	-	-	♀	-	-	♀
3314[95*]	-	S	-	Y	-	N	Y	N[23]	N[23]	-	-	N

Spruce-Fir Construction Area (SFC) Midden Occupancy 1996												
Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[27]	Aug[27]	Sep	Oct[29]	Nov	Dec
3315[95*]	♀[*2]	♀[*2]	♀[*2]	♀[*2]	-	♀[*2]	♀[*2]	-	♀[24]	♀	-	S
3316[95*]	-	♀	-	♀	-	♀+2	-	-	♀	-	-	S
3317[95*]	-	♀	-	Y	-	♀L	-	S	♀	-	-	S
3318[95*]	-	♀	-	♀	-	♀L	-	S	N	-	-	N
3319[95*]	-	♀	-	♀	-	♀	-	-	S[21]	P	-	S
3320[95*]	-	♀	-	♀	-	♀[26]	-	♀[26]	♀	♀	-	♀[26]
3321[95*]	♂	♂	-	Y	-	Y	♂	N	N	-	-	N
3322[95*]	-	♀	-	S	-	♀L	J	♀J	N	N	-	N
3323[95*]	-	♂	-	♂	-	♂	-	♀	♂[22]	S	-	♂
3324[95*]	-	♀	-	♀	-	♀L[15]	-	N[15]	N[15]	N	-	P[15]
3325[95*]	-	♀	-	Y	-	♀+3	-	♀[17]	♀[17]	♀[17]	-	S[17]
3326[95*]	-	♂	-	♂	-	♂	-	P	♀[26]	-	-	N
3327[95*]	-	♂	-	Y	-	N	-	P	N	N	-	N
3328[95*]	-	Y	-	Y	-	N	-	-	N	-	-	N
3329[95*]	-	♀	-	S	-	♀L	-	-	♀	-	-	Y
3330[95*]	-	♀	-	S	-	♀	-	-	♀	S	-	S
3331[95*]	-	♀	-	Y	-	♀[18]	-	-	♀	-	-	♀
3332[95*]	-	♂	-	S	-	N[18]	-	-	N	-	-	N
3333[95*]	-	S	-	Y	-	♂	-	-	N	-	-	N
3334[95*]	-	♂	-	Y	-	N	-	-	N	N	-	N
3335[95*]	-	♀	-	♀	-	N[19]	-	-	N	-	-	N
3336[95*]	-	♀	-	P	-	N	-	-	N	N	-	N
3337[95*]	-	♀	-	N	-	N	-	-	N	N	-	N
3338[95*]	Y	♀	-	Y	-	♀L	-	S	N[24]	-	-	N
3339[95*]	-	♀	-	♀	-	N	-	-	N	-	-	N
3340[95*]	Y	♀	-	Y	♀L[20]	♀L	Y	P	N	N	-	N
3341[95*]	-	♀	-	S	-	♂	-	-	S	-	-	S
3342[95*]	-	S	-	S	-	♀	-	-	S	-	-	♀
3343[95*]	-	♂	-	♀	-	♀	-	-	S	-	-	S
3344[95*]	-	S	-	P	-	N	-	-	N	-	-	N
3345[95*]	Y	Y	-	Y	-	N	-	-	N	N	-	N
3346[95*]	-	♀	-	Y	-	N	-	N	N	N	-	N
3347[95*]	-	♂	-	♂	-	N	-	-	N	N	-	N
3348[95*]	-	♂	-	Y	-	S	-	-	N	-	-	N
3349[95*]	-	♀	-	♂	-	♀	-	-	N	-	-	N
3350[87]	-	♂	-	♂	-	♂	-	♂	♂	♂	-	♂
3351[87]	-	♂	-	♂	-	♂	♂	-	♂	-	-	♂
3352[86]	-	N	-	N	-	N	-	-	N	-	-	N

Spruce-Fir Construction Area (SFC) Midden Occupancy 1996

Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[27]	Aug[27]	Sep	Oct[29]	Nov	Dec
3353[87]	-	♂	-	P	-	♀	-	S	♀	-	-	S
3354[86]	-	Y	-	♀	-	♂	-	N	N	N	-	N
3355[95*]	-	♂	-	♂	-	♂	-	-	N[25]	-	-	N
3356[86]	S	♀	-	♀	-	♀	-	♂	♂[25]	-	-	S
3357[86]	-	N	-	N	N[20]	N	N	-	N	N	-	N
3358[87]	-	♂	-	N	-	N ✖						
3359[87]	-	N	-	N	-	N ✖						
3360[86]	♂[*3]	♂[*3]	Y	♂[*3]	-	♂[*3]	-	-	♂[*3]	-	-	♂[*3]
3361[86]	♀[*4]	♀[*4]	♀[*4]	♂	-	♂	-	-	♂	-	-	♂
3362[86]	♀[*5]	♀[*5]	Y	♀[*5]	-	♀L[*5]	♀[*5] +1	-	♀[5]	S	-	♀
3363[86]	♂	♂	-	♂	-	N	-	N	N	N	-	N
3364[86]	P	N	-	N	-	N	N[13]	N	N	N	-	N
3365[86]	S	♂[*11]	♂[*13]	Y	-	♂[*13]	♂[*13]	♂[*13]	♂[*13]	♂[*13]	-	♂[*13]
3366[86]	-	♀	-	♀	-	♂	-	-	♂	-	-	♂[26]
3367[87]	♂	♂	-	♂	-	♂	-	S	♂	-	-	♂
3368[86]	-	Y	-	S	-	♂	-	-	♂	♂	-	S
3369[86]	-	♀	-	♀L	-	♀+3	-	-	♀	-	-	♀
3370[86]	-	N	-	N	-	N	-	-	S	-	-	P
3371[87]	-	♀	-	♂	-	♂	-	-	♂	-	-	S
3372[89]	-	♀	-	♀	-	♀	-	-	♀	-	-	S
3373[87]	-	♀	-	Y	-	♀	-	-	♀	-	-	♀
3374[89]	-	♂	-	♂	-	♂	-	-	♂	-	-	♂
3375[86]	-	♂	-	♂	-	♂[19]	♂	-	♂	-	-	S
3376[86]	-	N	-	N	-	N	-	-	N	-	-	N
3377[87]	-	♀	-	♀	-	♀L	-	-	♀	-	-	♀
3378[90*]	-	♂	-	S	-	♀	♂	S	♂	-	-	S
3379[90*]	-	♂	-	♂	-	♂[16]	-	♂[16]	♂[16]	♂	-	♂[16]
3380[90*]	-	N	-	N	-	N	-	-	N	-	-	N
3381[90*]	S	♀[12]	-	♀	-	♀L	-	-	P	-	-	N
3382[91*]	S	♂	-	S	♂[20]	♂	♂	-	♂	S	-	♂
3383[91*]	-	♀	-	P	-	♀	-	P	N	N	-	N
3384[91*]	-	♀	-	N	-	N ✖						
3385[91*]	-	N	-	N	-	N	-	-	N	N	-	N
3386[91*]	-	♀	-	♀L	-	♀L	-	-	♂	-	-	N
3387[91*]	-	♂	-	♂	-	♂	♂	-	♂[26]	-	-	♂
3388[92*]	-	N	-	N	-	N	-	-	N	-	-	N
3389[93*]	-	♂	-	♂	-	♂[17]	-	-	N[17]	N	-	N
3390[93*]	-	♀	-	♂	-	♂	-	-	♀	-	-	S

Spruce-Fir Construction Area (SFC) Midden Occupancy 1996												
Midden	Jan[1]	Feb	Mar[1]	Apr	May	June	July[27]	Aug[27]	Sep	Oct[29]	Nov	Dec
3391[93*]	-	S	-	N	-	S	-	N	N	N	-	N
3392[93*]	♂[*6]	♂[*6]	♂	♂[*6]	-	♂	-	♂[6]	♂[6]	-	-	S
3393[93*]	-	♂	-	♂	-	♂	-	P	S	-	-	S
3394[93*]	♂[*7]	♂[*7]	♂[*7]	♂[*7]	-	♂[*7]	-	-	♂[*7]	-	-	♂[*7]
3395[94*]	-	N	-	N	-	N	-	-	N	-	-	N
3396[94*]	-	♀	-	Y	-	♀L	-	-	S	-	-	Y
3397[86]	-	♂	-	Y	-	♂	-	-	♂	-	-	♂
3398[86]	-	N	-	N	-	N	-	-	N	-	-	N
3399[94*]	-	♂[8]	-	S	-	♂	-	-	♂	-	-	♂
# Mid	-	121	-	122	-	**113**[28]	-	-	113	-	-	113
# Occ	-	106	-	96	-	76	-	-	61	-	-	55
% Occ	-	88	-	79	-	67	-	-	54	-	-	49
# Sq	-	106	-	96	-	76+9	-	-	61	-	-	55

[1] A full census was not conducted. Middens where marked squirrels were seen in the previous quarter were checked. In addition, other middens near the marked squirrel middens may have been checked.

[2] Marked female (Y/Y) Y/-.

[3] Marked male (B/G) (-/G) -/metal tag by June 96.

[4] Marked female Y/B.

[5] Marked female (R/Y) -/ Y. The marked female was seen in the midden on 10 July with at least one juvenile. There may have been a second juvenile but this could not be confirmed. The marked female was not seen in Sep 96, a ♀ young of the year was living in the midden.

[6] Marked male (R/R) R/-. The ♂ seen in Aug and Sep had a rip in his right ear - there was no sign of a tag or rip in the left ear. This was assumed be a different male than the marked male previously in the midden.

[7] Marked male -/- (rips in both ears) is assumed to be ♂ W/O, marked in Oct 1995.

[8] ♂ from midden 3399 appears to be using midden 3000 as well.

[9] ♀ from midden 3300 appears to be using midden 3301 as well.

[10] Marked male O/O.

[11] Marked male (B/R) -/R.

SFC (cont.)

[12] Female at midden 3381 was observed building a grass nest.

[13] Marked male (W/R) W/-. During June and July this marked ♂ was seen several times in midden 3020, feeding and defending the midden. He was also seen several times taking cones from midden 3364. By August, a female with a notched ear had moved into midden 3020.

[14] Midden 3021 was completely burned in the Clark Peak fire. Some feeding sign was located in the midden, but no red squirrel has been seen.

[15] Midden 3324 was on the edge of a hot burn from the Clark Peak fire. A few logs in the midden were burned, but some caches remained intact. A lactating female was seen in the midden in June. In August and September, this midden was inactive but the ♂ from midden 3379 was seen here several times. In December, the male from midden 3379 appeared to still be using midden 3324.

[16] The Clark Peak fire burned right up to the plaque tree of midden 3379, but the main snag and the midden material remained intact. A♂ RS was seen in June using the snag and feeding on cones in the midden. By September, this male was still using the snag area, but he had also established some caches between 3379 and 3324. He was also observed several times foraging in midden 3324. In December, this male appeared to still be using midden 3324.

[17] The main area of activity at midden 3389 had shifted ~15m E of the plaque tree. This midden shift area was completely burned in the Clark Peak fire. The plaque tree area remained intact. A male RS was seen several times in the burned area, gathering cones. This male was last seen in mid-June. By the end of June a ♀L was seen feeding on the edge of the burn. This was likely the same ♀L seen in midden 3325. By September, the 3389 plaque tree area was inactive and there was no use of the burned area. Also in September, the ♀ (missing 1/4 of tail) from 3325 had several caches between 3389 and her own midden and was seen frequently foraging in midden 3389. This midden will remain in the active census list even though the main (shifted) part of the midden was completely burned. The old midden site (plaque tree) is being used by the squirrel at 3325. In October, a female with a short tail was seen in midden 3325. In December, a squirrel with a short tail was seen in midden 3325.

[18] The ♀ at midden 3331 appears to be using midden 3332 also.

[19] The ♂ at midden 3375 has a notch in his left ear. He appears to be using midden 3335 also.

[20] These three middens are within the 100ft fire protection zone around the telescope sites and were visited during a one day trip to Mt. Graham on 22 May. The lactating ♀ at midden 3340 had a torn left ear, and was assumed to be the same ♀ with a torn left ear that established the midden in December 1995. Additionally, the lactating ♀ at midden 3340 was seen during a one day trip on 7 May.

[21] The squirrel at midden 3319 and the ♂ at midden 3306 appear to be using midden 3005 also.

[22] The ♂RC at midden 3309 and the ♂ at midden 3323 appear to be using midden 3022 also.

[23] The ♀ (notch in left ear) from midden 3020 appears to be using midden 3314 also. This female was seen in several locations on Emerald Peak during June and July. In August, she was seen in several territorial disputes with the marked male at 3365 over midden 3020. By the end of August, she had taken over the midden.

[24] The unmarked ♀ from midden 3315 appears to be using the area around midden 3338 also.

[25] The ♂ from midden 3356 appears to be using midden 3355 also.

SFC (cont.):

[26] Squirrel has a natural identifying mark such as an ear notch, short tail, etc.

[27] A complete census was not conducted in July and August, but several middens were checked during other monitoring activities.

[28] The number of middens in June includes midden 3389. The shifted area was completely burned (see footnote # 17 for further details). Originally this midden was not counted in the June totals, because the main activity area was destroyed. In September 1996, this midden was added back to the total number of middens, because the actual plaque tree did not burn and a ♀ red squirrel from a nearby midden was seen in the area several times. In December 1996, it was decided to ammend the June midden totals to include midden 3389. This was mainly because most of the statistical comparisons for the RSMP Annual Report use data from June and December.

[29] Only middens within approximately 100m of contruction and the access road were censused.

[30] The male squirrel at midden 3309 now has a short tail in addition to the radio collar.

Spruce-Fir Non-construction Area (SFN) Midden Occupancy 1996												
Midden	Jan	Feb	Mar	Apr	May	June	July[10]	Aug[10]	Sep	Oct	Nov	Dec
4000[95*]	-	♀	-	♀	-	♀L	-	-	♀	-	-	♀
4001[95*]	-	♂	-	S	-	N	-	-	N	-	-	S
4002[95*]	-	♀	-	♀L	-	♀L	-	-	♀	-	-	S
4003[95*]	-	S	-	♀	-	♀	-	-	S	-	-	S
4004[95*]	-	N	-	P	-	N	-	-	N	-	-	N
4005[95*]	-	♀	-	Y	-	Y	-	-	N	-	-	N
4006[95*]	-	Y	-	N	-	N	-	-	N	-	-	N
4007[95*]	-	N	-	N	-	N	-	-	N	-	-	N
4008[95*]	-	♂	-	S	-	♂	-	-	♂	-	-	♂
4009[95*]	-	N	-	N	-	N	-	-	N	-	-	N
4010[95*]	-	P	-	N	-	N	-	-	N	-	-	N
4011[95*]	-	♀	-	Y	-	P	-	-	N	-	-	N
4012[95*]	-	♀	-	Y	-	N	-	-	N	-	-	N
4013[96*]	new	♂	-	♂	-	♂	-	-	♂	-	-	♂
4014[96*]	new	♂	-	Y	-	N	-	-	N	-	-	Y
4015[96*]	new	♀	-	Y	-	N	-	-	N	-	-	N
4016[96*]	new	♂	-	Y	-	N	-	-	♂	-	-	S
4017[96*]	new	♀	-	P	-	Y	-	-	N	-	-	Y
4018[96*]	new	S	-	♀	-	N	-	-	S	-	-	N[11]
4019[96*]	new								♀	-	-	N
4020[96*]	new								♀	-	-	N
4400[89]	-	N	-	N	-	N	-	-	N	-	-	N
4401[94*]	-	♂	-	Y	-	N	-	-	N	-	-	N
4402[94*]	-	♀	-	♀	-	♀	-	-	♀	-	-	S[11]
4403[94*]	-	N	-	♀	-	S	-	-	N	-	-	N
4404[95*]	-	♀	-	♀	-	♀	-	-	♀	-	-	S
4405[95*]	-	S	-	Y	-	♀	♀	-	S	-	-	S
4406[95*]	-	♂	-	♂	-	P	-	-	N	-	-	N
4407[95*]	-	♂	-	N	-	♂	-	-	S[8]	-	-	Y
4408[95*]	-	Y	-	♂	-	S	Y	-	S	-	-	Y
4409[95*]	-	♀	-	Y	-	♂	-	-	♂	-	-	S
4410[95*]	-	♀	-	Y	-	♀L	-	-	♀	-	-	♀
4411[95*]	-	♀	-	Y	-	♀L	-	-	N[5]	-	-	N
4412[95*]	-	♀	-	Y	-	♀L	-	-	♀	-	-	S[13]
4413[95*]	-	♀	-	♀	-	♀	-	-	♀	-	-	♀
4414[95*]	-	♂	-	Y	-	P[2]	-	-	N	-	-	N

Spruce-Fir Non-construction Area (SFN) Midden Occupancy 1996												
Midden	Jan	Feb	Mar	Apr	May	June	July[10]	Aug[10]	Sep	Oct	Nov	Dec
4415[95*]	-	♀	-	Y	-	Y+1	-	-	♀	-	-	Y
4416[95*]	-	♀	-	♀	-	♀L	-	-	N	-	-	S
4417[95*]	-	♂	-	♂	-	♂	-	-	S	-	-	S
4418[95*]	-	♀	-	P	-	Y	Y	-	N	-	-	N
4419[95*]	-	♂	-	Y	-	N	-	-	N	-	-	S
4420[90]	-	S	-	♂	-	♂	-	-	♂	-	-	S
4421[86]	-	Y	-	♀L	-	♀+1	-	-	♀	-	-	♀
4422[86]	-	♂	-	♂	-	♂	-	-	S	-	-	S
4423[86]	-	♂	-	♂	-	♂	-	-	♂	-	-	♂
4424[86]	-	N	-	N	-	N	-	-	N	-	-	♂[12]
4425[87]	-	N	-	N	-	N	-	-	N	-	-	N[12]
4426[86]	-	♀	-	Y	-	♂	-	-	N	-	-	N
4427[86]	-	♂	-	Y	-	♂	♂	-	♂[1]	-	-	♂
4428[86]	-	♀	-	♀	-	S	Y	-	♀[1]	-	-	S
4429[86]	-	♂	-	S	-	♂	-	-	♂	-	-	Y
4430[86]	-	N	-	N	-	N	-	-	♀[9]	-	-	P[13]
4431[86]	-	♂	-	♂	-	♂	-	-	♂[6]	-	-	Y
4432[86]	-	♂	-	Y	-	♂	-	-	♂	-	-	S
4433[87]	-	♀	-	Y	-	N	-	-	N	-	-	N
4434[86]	-	N	-	N	-	N	-	-	N	-	-	N
4435[86]	-	♂	-	S	-	♂	-	-	♂[1]	-	-	♂
4436[86]	-	♂	-	Y	-	♂	-	-	♀	-	-	P
4437[95*]	-	♂	-	Y	-	♂	-	-	N[6]	-	-	N
4438[90*]	-	♀	-	Y	-	♂[1]	-	-	♂[1]	-	-	S[1]
4439[90*]	-	♂	-	S	-	♀L	-	-	N[7]	-	-	N
4440[91]	-	N	-	N	-	N	-	-	N	-	-	N
4441[86]	-	Y	-	N	-	N	-	-	N	-	-	N
4442[95*]	-	♂	-	Y	-	♂	-	-	N	-	-	N[14]
4443[86]	-	♀	-	♀	-	♀L	-	-	♂	-	-	S[14]
4444[86]	-	♂	-	♂	-	♂	-	-	♀	-	-	S
4445[86]	-	S	-	♂	-	♂	-	-	♂[5]	-	-	S
4446[86]	-	N	-	N	-	N	-	-	N	-	-	N
4447[86]	-	♂	-	♂	-	♂	-	-	♂	-	-	♂
4448[86]	-	N	-	N	-	N	-	-	N	-	-	N
4449[86]	-	♂	-	Y	-	♂	-	-	♂	-	-	♂
4450[86]	-	N	-	N	-	N	-	-	♂	-	-	♂
4451[88]	-	N	-	N	-	N	-	-	N	-	-	N
4452[86]	-	S	-	Y	-	♂	-	-	♂	-	-	Y

Spruce-Fir Non-construction Area (SFN) Midden Occupancy 1996												
Midden	Jan	Feb	Mar	Apr	May	June	July[10]	Aug[10]	Sep	Oct	Nov	Dec
4453[86]	-	N	-	N	-	N	-	-	N	-	-	N
4454[86]	-	N	-	N	-	N	-	-	N[8]	-	-	N
4455[86]	-	N	-	N	-	N	-	-	N	-	-	N
4456[86]	-	N	-	N	-	N	-	-	N	-	-	N
4457[86]	-	♀	-	S	-	♀L	-	-	S	-	-	Y
4458[86]	-	N	-	N	-	N	-	-	N	-	-	N
4459[86]	-	N	-	N	-	N	-	-	N	-	-	N
4460[87]	-	Y	-	N	-	Y	-	S	N	-	-	S
4461[91*]	-	♂	-	♂	-	♂	♂	-	♂	-	-	N
4462[90]	-	♀	-	N	-	N	-	-	N	-	-	N
4463[90]	-	♂	-	♀	-	♀	-	-	♀	-	-	S
4464[90]	-	N	-	N	-	N	-	-	N	-	-	P
4465[90*]	-	Y	-	S	-	♀+2	-	-	♀	-	-	♀
4466[87]	-	S	-	P	-	♂[3]	-	-	♂[3]	-	-	♂[3]
4467[87]	-	♂	-	Y	-	♂	-	-	♂	-	-	♂
4468[87]	-	N	-	N	-	N	-	-	N	-	-	N
4469[87]	-	♀	-	♀L	-	Y+2[4]	-	-	♀	-	-	Y
4470[87]	-	♂[1]	-	Y	-	♂[1]	S	-	♂[1]	-	-	♂[1]
4471[87]	-	♂	-	♂	-	♂	-	-	♂	-	-	Y
4472[87]	-	S	-	Y	-	♀L	-	-	♀	-	-	♀
4473[87]	-	♀	-	♀	-	♀L	-	-	♀	-	-	♀
4474[86]	-	♂	-	Y	-	♂	-	-	♂	-	-	♂
4475[87]	-	♂	-	♂	-	♀+2	-	-	♀	-	-	S
4476[95*]	-	♂	-	Y	-	N	-	-	N	-	-	N
4477[87]	-	♂	-	♂	-	♂	-	-	♂	-	-	S
4478[90*]	-	N	-	N	-	N	-	-	N	-	-	N
4479[90*]	-	N	-	N	-	N	-	-	N	-	-	N
4480[90*]	-	N	-	N	-	N	-	-	N	-	-	N
4481[86]	-	S	-	Y	-	N	-	-	N	-	-	N
4482[86]	-	♀	-	N	-	N	-	-	N	-	-	N
4483[86]	-	N	-	N	-	N	-	-	N	-	-	N
4484[86]	-	♂	-	P	-	N	-	-	N	-	-	N
4485[86]	-	N	-	N	-	N	-	-	N	-	-	N
4486[86]	-	N	-	N	-	N	-	-	N	-	-	N
4487[86]	-	N	-	N	-	N	-	-	N	-	-	N
4488[91*]	-	N	-	N	-	N	-	-	N	-	-	N
4489[91*]	-	N	-	N	-	N	-	-	N	-	-	N
4490[91*]	-	♀	-	♀	-	N	-	-	♂	-	-	♂

Spruce-Fir Non-construction Area (SFN) Midden Occupancy 1996												
Midden	Jan	Feb	Mar	Apr	May	June	July[10]	Aug[10]	Sep	Oct	Nov	Dec
4491[91*]	-	♀	-	Y	-	P	-	-	N	-	-	N
4492[91*]	-	N	-	N	-	N	-	-	N	-	-	N
4493[91*]	-	N	-	N	-	N	-	-	N	-	-	N
4494[91*]	-	♂	-	P	-	N	-	-	♀[7]	-	-	♀
4495[95*]	-	♂	-	♂	-	♂	-	-	S	-	-	S
4496[93*]	-	N	-	♂	-	N[3]	-	-	N[3]	-	-	N[3]
4497[93*]	-	♀	-	♀	-	♀L	-	-	N[9]	-	-	N
4498[93*]	-	♀	-	Y	-	♀L	-	-	♀	-	-	S
4499[93*]	-	♀	-	Y	-	♀L	-	-	S	-	-	S
# Mid	-	119	-	119	-	119	-	-	121	-	-	121
# Occ	-	84	-	75	-	63	-	-	59	-	-	60
% Occ	-	71	-	63	-	53	-	-	49	-	-	50
# Sq	-	84	-	75	-	63+8	-	-	59	-	-	60

[1] Squirrel has a natural identifying mark such as an ear notch, short tail, etc.

[2] A young of the year ♂ was seen one time in midden 4414 at the end of the month. It was not clear if he had established residency or just passing through.

[3] The ♂ at midden 4466 appears to be using midden 4496 as well.

[4] A third red squirrel was heard chattering in midden 4469 with the two juveniles in sight. It was not known whether this third red squirrel was the adult ♀ or a third juvenile.

[5] The ♂ at midden 4445 appears to be using midden 4411 also.

[6] The ♂ at midden 4431 appears to be using midden 4437 also.

[7] The ♀ at midden 4494 appears to be using midden 4439 also.

[8] The squirrel at midden 4407 appears to be using midden 4454 also.

[9] The ♀ at midden 4430 appears to be using midden 4497 also.

[10] A complete census was not conducted in July and August, but several middens were checked during other monitoring activities.

[11] The squirrel from midden 4402 appears to be using midden 4018 also.

[12] The male from midden 4424 appears to be using midden 4425 also.

[13] The squirrel from midden 4412 appears to be using midden 4430 also.

[14] The squirrel from midden 4443 appears to be using midden 4442 also.

Appendix E. Clark Peak Fire

Appendix E-1. Area (in hectares) intensely burned for the four monitored areas.

Appendix E-2. Number of middens intensely burned or fire damaged on the four monitored areas.

Appendix E-3. Number of middens affected by fire suppression on the four monitored areas.

Appendix E-4. List of fire and /or suppression damage to middens censused by the monitoring program, including midden occupancy before and after the Clark Peak Fire.

Appendix E. Clark Peak Fire

Parts of the monitored areas within the containment perimeter were catastrophically burned and are no longer viable red squirrel habitat. On the TRC area approximately 61 ha or 73% of the area was within the fire containment perimeter. Of this area, approximately 34.5 ha or 41% of the area was intensely burned (all trees and ground cover consumed). Twenty-three (23) red squirrel middens were completely destroyed. On the SFC area, approximately 40 ha (40% of the area) were encompassed by the containment perimeter and 24.9 ha (25%) were intensely burned. Ten (10) midden sites were destroyed on the SFC. Midden 3389 had a shifted area of caching and feeding ~15m E of the plaque tree. This area was completely burned, but the plaque tree remained intact. Therefore, this midden was not counted as completely destroyed, but it did sustain heavy damage.

Appendix E-1. Area (in hectares) intensely burned for the four monitored areas.

Area	Total Size (ha)	Intensely Burned Area (ha)	% of Area Intensely Burned
TRC	83.6	34.5	41
TRN	24.4	0.0	0
SFC	101.0	24.9	25
SFN	128.9	0.0	0
TOTAL	337.9	59.4	18

Appendix E-2. Number of middens intensely burned or fire damaged on the four monitored areas. (Note: some middens have both fire and suppression damage)

Area	Total # Middens Before Fire	# Middens W/in Containment Perimeter	Intensely Burned	Fire Damage W/in 15m
TRC	54	26	23	5
TRN	31[1]	0	0	0
SFC	123[1]	38	10[2]	23
SFN	119	0	0	0
Off-Area	25	1	0	2
Total	352	65	33	30

[1] These numbers include two middens that were first located in June, but had obviously had been active for several months.

[2] Midden 3389 had a shifted area of caching and feeding ~15m E of the plaque tree. This area was completely burned, but the plaque tree remained intact. Therefore, this midden was not counted as completely destroyed, but it did sustain heavy damage.

Appendix E-3. Number of middens affected by fire suppression on the four monitored areas. (Note: some middens have both fire and suppression damage)

Area	Total # Middens Before Fire	# Middens W/in Containment Perimeter	Hand-line w/in 15m	Dozer-line w/in 15m	Direct suppression w/in midden (logs/trees cut)	Cutting w/in midden, no other fire or supp. nearby
TRC	54	26	1	4	0	0
TRN	31[1]	0	0	2	0	0
SFC	123[1]	38	8	0	6	2
SFN	119	0	0	0	0	0
Off-Area	25	1	0	1	0	0
Total	352	65	9	7	6	2

[1] These numbers include two middens that were first located in June, but obviously had been active for several months.

Appendix E-4. List of fire and /or suppression damage to middens censused by the monitoring program, including midden occupancy before and after the Clark Peak Fire.

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
1101	no fire or suppression damage	Y	M
1102	no fire or suppression damage	N	N
1103	no fire or suppression damage	F	S
1104	plaque tree to dozer line 17m @90d	M	N
1105	complete burn	M	N
1106	dozer line 1m E of plaque tree, ground fire E of dozer line, complete burn ~25mSE	Y	M
1107	complete burn	N	N
1108	spots all~Mid, complete burn 20m E, dozer line to Mid 48m@100d	Y	P
1109	complete burn	Y	N
1110	complete burn	Y	N
1111	no fire or suppression damage	N	N
1112	no fire or suppression damage	N	P
1113	no fire or suppression damage	Y	S
1114	no fire or suppression damage	N	N
1115	dozer line to plaque tree 48m@299d	N	N
1116	plaque tree to dozer line 30m@90d, 33m @135d (corner)	S	M
1117	complete burn	N	N
1118	dozer line to plaque tree 48m@0d	F	S
1119	complete burn	F	N
1120	complete burn	Y	N
1121	dozer line to plaque tree 49m@280d	Y	M
1122	complete burn	N	N
1123	complete burn	P	N
1124	complete burn	N	N
1125	complete burn	N	N
1126	plaque tree to dozer line 4m @280d, ground fire at Mid center	P	N
1130	nearly complete burn	M	N
1131	dozer line to plaque tree 23m@45d	F	M
1132	plaque tree to dozer line 12m@270d, spots E, main caches damaged	N	N
1134	no fire or suppression damage	N	N
1135	complete burn, but close to unburned area, RS using Mid	M	M

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
1136	complete burn	N	N
1137	complete burn, dozer line to plaque tree 39m@96d	Y	N
1138	dozer line to plaque tree 42m@268d	N	N
1139	complete burn	Y	N
1140	complete burn	N	N
1141	complete burn	F	N
1142	complete burn	Y	N
1143	complete burn	S	N
1144	plaque tree to dozer line 14m@80d	S	F/M
1145	no fire or suppression damage	N	N
1146	no fire or suppression damage	N	N
1147	no fire or suppression damage	M	M
1148	complete burn	Y	N
1149	no fire or suppression damage	Y	F
1150	no fire or suppression damage	N	N
1151	dozer line to plaque tree 31m@36d, complete burn ~50mE, slurry drop	N	N
1152	complete burn - F RS seen in Mid early in June	FL	N
1153	no fire or suppression damage	N	N
1154	hand line 5m NW of M; dozer line 25m SW; few sm trees cut; spot fire 12 m S	Y	M
1155	no fire or suppression damage	N	N
1156	dozer line to plaque tree 22m@265d, 44m@340d (corner)	N	N
1157	no fire or suppression damage	S	M
1159	complete burn	M	N
2201	no fire or suppression damage	M	M
2202	no fire or suppression damage	F	F
2203	no fire or suppression damage	M	M
2204	no fire or suppression damage	N	N
2205	no fire or suppression damage	F	F
2206	no fire or suppression damage	Y	M
2207	hand line to plaque tree 43m@330d	N	N
2208	no fire or suppression damage	P	M
2209	plaque tree to dozer line 10m@90d	N	N
2210	no fire or suppression damage	Y	M
2211	no fire or suppression damage	F	S

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
2212	plaque tree to dozer line 8m@90d, mid shift to dozer line 18m@90d	F	F
2213	no fire or suppression damage	N	N
2214	no fire or suppression damage	Y	FL
2215	no fire or suppression damage	Y	N
2216	no fire or suppression damage	N	N
2217	no fire or suppression damage	F	M
2218	no fire or suppression damage	N	N
2219	no fire or suppression damage	N	N
2220	no fire or suppression damage	N	N
2221	dozer line to plaque tree 17m@304d, slurry	N	N
2222	no fire or suppression damage	N	N
2223	no fire or suppression damage	N	N
2224	no fire or suppression damage	N	N
2225	no fire or suppression damage	N	N
2226	plaque tree to dozer line 16m@270d	Y	F
2227	plaque tree to dozer line 16m@270d	Y	N
2228	no fire or suppression damage	M	F
2229	no fire or suppression damage	P	FL
2230	no fire or suppression damage	M	M
2231	no fire or suppression damage	-	FL
3000	no fire or suppression damage	M	N
3001	no fire or suppression damage	S	M
3002	spot 10m@64d from plaque tree	P	N
3003	spots w/in 10m of plaque tree	N	N
3004	complete burn	F	N
3005	spots 15-20m E, hand line to plaque tree 19m@186d	Y	Y
3006	hand line to plaque tree 11m@255d, 10m@164d (corner)	F	M
3007	no fire or suppression damage	Y	N
3008	no fire or suppression damage	Y	FL
3009	no fire or suppression damage	Y	N
3010	no fire or suppression damage	N	N
3011	spot 5m @260d from plaque tree	M	M
3012	intense ground fire, trees scorched	F	N
3013	spots in Mid	F	Y

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
3014	spot 3m E of plaque tree	P	Y
3015	complete burn	S	N
3016	complete burn	Y	N
3017	complete burn	Y	N
3018	complete burn	Y	N
3019	no fire or suppression damage	Y	N
3020	no fire or suppression damage	Y	N
3021	complete burn	S	N
3022	no fire or suppression damage	-	FL
3300	no fire or suppression damage	Y	F+1
3301	no fire or suppression damage	N	N
3302	no fire or suppression damage	N	N
3303	no fire or suppression damage	Y	FL
3304	no fire or suppression damage	N	N
3305	no fire or suppression damage	F	F
3306	hand line to plaque tree 12m@58d	M	M
3307	hand line to plaque tree 6m@196d, complete burn~10-15m away, slurry	F	F
3308	hand line to plaque tree 36m@355d	F	M
3309	spots 9 and 16m S	M	MRC
3310	dozer line to plaque tree 32m@69d	Y	N
3311	no fire or suppression damage	M	M
3312	no fire or suppression damage	S	F
3313	no fire or suppression damage	S	N
3314	no fire or suppression damage	Y	N
3315	no fire or suppression damage	MF	MF
3316	no fire or suppression damage	F	F+2
3317	no fire or suppression damage	Y	FL
3318	1 sm spot in mid, logs cut in mid, 1sm tree cut w/in 15m, other spots to the NE and SE	F	FL
3319	spots 12m NE and 9m E from plaque tree	F	F
3320	spots just uphill of plaque tree, cache log burned	F	F
3321	spot 5m NW, hand line to plaque tree 10m@96d, trees, logs cut nearby	Y	Y
3322	no fire or suppression damage	S	FL
3323	2 spots in Mid, caches not affected	M	M
3324	half of Mid complete burn	F	FL

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
3325	spot fire next to main cache, more spots w/in 20m	Y	F+3
3326	3 big live trees cut in Mid, hand line to plaque tree 45m@181d, spot fires ~20mSW, more trees	M	M
3327	main snag complete burn and fell over, big spot fire	Y	N
3328	plaque tree to dozer line 18m@235d	Y	N
3329	no fire or suppression damage	S	FL
3330	no fire or suppression damage	S	F
3331	no fire or suppression damage	Y	F
3332	no fire or suppression damage	S	N
3333	no fire or suppression damage	Y	M
3334	no fire or suppression damage	Y	N
3335	no fire or suppression damage	F	N
3336	intense ground fire in Mid, ~35mE of complete burn	P	N
3337	no fire or suppression damage	N	N
3338	no fire or suppression damage	Y	FL
3339	hand line to plaque tree 6m@10d	F	N
3340	2 sm trees cut on edge of Mid	Y	FL
3341	no fire or suppression damage	S	M
3342	no fire or suppression damage	S	F
3343	no fire or suppression damage	F	F
3344	no fire or suppression damage	P	N
3345	no fire or suppression damage	Y	N
3346	no fire or suppression damage	Y	N
3347	no fire or suppression damage	M	N
3348	spot 10m@230d from plaque tree	Y	S
3349	no fire or suppression damage	M	F
3350	plaque tree/snag complete burn and fell over, spot in Mid, RS activity uphill before fire	M	M
3351	hand line to Mid shift area 38m@8d	M	M
3352	spots w/in 10m of plaque tree, 2 snags burned	N	N
3353	2 snags cut in Mid, few other trees cut outside 15m radius, no other burn or suppression nearby	P	F
3354	spot 10m E-SE of Mid, at Mid shift - 2 more spots w/in 15m	F	M
3355	no fire or suppression damage	M	M
3356	hand line to plaque tree15m@320d; some big trees cut on hand line	F	F
3357	sprinkler line through Mid, some trees cut	N	N
3358	complete burn	N	N

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
3359	intense ground fire, trees scorched	N	N
3360	hand line to plaque tree 27m@82d	MM	MM
3361	no fire or suppression damage	M	M
3362	Mid shift to hand line 34m@238d	MF	MF
3363	no fire or suppression damage	M	N
3364	no fire or suppression damage	N	N
3365	no fire or suppression damage	Y	MM
3366	no fire or suppression damage	F	M
3367	no fire or suppression damage	M	M
3368	no fire or suppression damage	S	M
3369	no fire or suppression damage	FL	F+3
3370	no fire or suppression damage	N	N
3371	no fire or suppression damage	M	M
3372	no fire or suppression damage	F	F
3373	no fire or suppression damage	Y	F
3374	no fire or suppression damage	M	M
3375	no fire or suppression damage	M	M
3376	no fire or suppression damage	N	N
3377	no fire or suppression damage	F	FL
3378	hand line to plaque tree 51m@166d, spots w/in 20m	S	F
3379	most of Mid complete burn	M	M
3380	no fire or suppression damage	N	N
3381	hand line to plaque tree 18m@321d	F	FL
3382	w/in 100 ft zone, no damage at plaque tree or Mid shift	S	M
3383	spots w/in 12m E and W	P	F
3384	complete burn	N	N
3385	no fire or suppression damage	N	N
3386	small spot 15m@65d from plaque tree, no damage to caches or main mid	FL	FL
3387	no fire or suppression damage	M	M
3388	no fire or suppression damage	N	N
3389	Mid shift 15m S-SE - complete burn, plaque tree not damaged	M	M
3390	main snag cut down	M	M
3391	spot fire in Mid center, 2 main Mid logs cut	N	S
3392	some logs cut in Mid, spot 20m E-SE, hand line to plaque tree 12m@258d	MM	M

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
3393	hand line to plaque tree 10m@316d, some trees/logs cut on S side of Mid	M	M
3394	no burn but several snags cut in Mid	MM	MM
3395	no fire or suppression damage	N	N
3396	no fire or suppression damage	Y	FL
3397	no fire or suppression damage	Y	M
3398	no fire or suppression damage	N	N
3399	no fire or suppression damage	S	M
4000	no fire or suppression damage	F	FL
4001	no fire or suppression damage	S	N
4002	no fire or suppression damage	FL	FL
4003	no fire or suppression damage	F	F
4004	no fire or suppression damage	P	N
4005	no fire or suppression damage	Y	Y
4006	no fire or suppression damage	N	N
4007	no fire or suppression damage	N	N
4008	no fire or suppression damage	S	M
4009	no fire or suppression damage	N	N
4010	no fire or suppression damage	N	N
4011	no fire or suppression damage	Y	P
4012	no fire or suppression damage	Y	N
4013	no fire or suppression damage	M	M
4014	no fire or suppression damage	Y	N
4015	no fire or suppression damage	Y	N
4016	no fire or suppression damage	Y	N
4017	no fire or suppression damage	P	Y
4018	no fire or suppression damage	F	N
4400	no fire or suppression damage	N	N
4401	no fire or suppression damage	Y	N
4402	no fire or suppression damage	F	F
4403	no fire or suppression damage	F	S
4404	no fire or suppression damage	F	F
4405	no fire or suppression damage	Y	F
4406	no fire or suppression damage	M	P
4407	no fire or suppression damage	N	M

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
4408	no fire or suppression damage	M	S
4409	no fire or suppression damage	Y	M
4410	no fire or suppression damage	Y	FL
4411	no fire or suppression damage	Y	FL
4412	no fire or suppression damage	Y	FL
4413	no fire or suppression damage	F	F
4414	no fire or suppression damage	Y	P
4415	no fire or suppression damage	Y	Y+1
4416	no fire or suppression damage	F	FL
4417	no fire or suppression damage	M	M
4418	no fire or suppression damage	P	Y
4419	no fire or suppression damage	Y	N
4420	no fire or suppression damage	M	M
4421	no fire or suppression damage	FL	F+1
4422	no fire or suppression damage	M	M
4423	no fire or suppression damage	M	M
4424	no fire or suppression damage	N	N
4425	no fire or suppression damage	N	N
4426	no fire or suppression damage	Y	M
4427	no fire or suppression damage	Y	M
4428	no fire or suppression damage	F	S
4429	no fire or suppression damage	S	M
4430	no fire or suppression damage	N	N
4431	no fire or suppression damage	M	M
4432	no fire or suppression damage	Y	M
4433	no fire or suppression damage	Y	N
4434	no fire or suppression damage	N	N
4435	no fire or suppression damage	S	M
4436	no fire or suppression damage	Y	M
4437	no fire or suppression damage	Y	M
4438	no fire or suppression damage	Y	M
4439	no fire or suppression damage	S	FL
4440	no fire or suppression damage	N	N
4441	no fire or suppression damage	N	N

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
4442	no fire or suppression damage	Y	M
4443	no fire or suppression damage	F	FL
4444	no fire or suppression damage	M	M
4445	no fire or suppression damage	M	M
4446	no fire or suppression damage	N	N
4447	no fire or suppression damage	M	M
4448	no fire or suppression damage	N	N
4449	no fire or suppression damage	Y	M
4450	no fire or suppression damage	N	N
4451	no fire or suppression damage	N	N
4452	no fire or suppression damage	Y	M
4453	no fire or suppression damage	N	N
4454	no fire or suppression damage	N	N
4455	no fire or suppression damage	N	N
4456	no fire or suppression damage	N	N
4457	no fire or suppression damage	S	FL
4458	no fire or suppression damage	N	N
4459	no fire or suppression damage	N	N
4460	no fire or suppression damage	N	Y
4461	no fire or suppression damage	M	M
4462	no fire or suppression damage	N	N
4463	no fire or suppression damage	F	F
4464	no fire or suppression damage	N	N
4465	no fire or suppression damage	S	F+2
4466	no fire or suppression damage	P	M
4467	no fire or suppression damage	Y	M
4468	no fire or suppression damage	N	N
4469	no fire or suppression damage	FL	Y+2
4470	no fire or suppression damage	Y	M
4471	no fire or suppression damage	M	M
4472	no fire or suppression damage	Y	FL
4473	no fire or suppression damage	F	FL
4474	no fire or suppression damage	Y	M
4475	no fire or suppression damage	M	F+2

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
4476	no fire or suppression damage	Y	N
4477	no fire or suppression damage	M	M
4478	no fire or suppression damage	N	N
4479	no fire or suppression damage	N	N
4480	no fire or suppression damage	N	N
4481	no fire or suppression damage	Y	N
4482	no fire or suppression damage	N	N
4483	no fire or suppression damage	N	N
4484	no fire or suppression damage	P	N
4485	no fire or suppression damage	N	N
4486	no fire or suppression damage	N	N
4487	no fire or suppression damage	N	N
4488	no fire or suppression damage	N	N
4489	no fire or suppression damage	N	N
4490	no fire or suppression damage	F	N
4491	no fire or suppression damage	Y	P
4492	no fire or suppression damage	N	N
4493	no fire or suppression damage	N	N
4494	no fire or suppression damage	P	N
4495	no fire or suppression damage	M	M
4496	no fire or suppression damage	M	N
4497	no fire or suppression damage	F	FL
4498	no fire or suppression damage	Y	FL
4499	no fire or suppression damage	Y	FL
5118	no fire or suppression damage	M	Y
5119	no fire or suppression damage	P	Y
5120	no fire or suppression damage	N	N
5121	no fire or suppression damage	F	S
5122	no fire or suppression damage	N	N
5123	no fire or suppression damage	FL	Y+2
5124	no fire or suppression damage	F	FL
5125	dozer line to plaque tree 30m@45d	M	M
5126	no fire or suppression damage	N	N
5127	dozer line to plaque tree 5m@180d, complete burn on N side of Mid	S	FL

Midden	Damage Description[1]	Occupancy[1]	
		Apr 96	Jun 96
5200	plaque tree to dozer line 16m@270d	Y	M
5350	no fire or suppression damage	Y	M
5351	no fire or suppression damage	Y	FL
5352	no fire or suppression damage	Y	S
5353	no fire or suppression damage	M	M
5354	no fire or suppression damage	Y	S
5355	no fire or suppression damage	N	N
5356	no fire or suppression damage	F	Y
5357	no fire or suppression damage	F	FL
5358	no fire or suppression damage	Y	FL
5359	no fire or suppression damage	Y	F
5360	no fire or suppression damage	Y	N
5361	spot 12m@65d from plaque tree	F	F
5362	plaque tree to dozer line 45m@217d	Y	Y
5475	no fire or suppression damage	Y	N

(Appendix E cont.)

1 Key

d	degrees (azimuth)
N	Not Occupied
P	Possibly Occupied, Red Squirrel sign found but unsure of residency
Y	Occupied, Red Squirrel sign indicates resident
S	Occupied, Red Squirrel sighted
F	Occupied, Adult female Red Squirrel
M	Occupied, Adult male Red Squirrel
J	Occupied, Juvenile Red Squirrel sex unknown
A	Abert's Squirrel using area, no Red Squirrel present
MM/F	Squirrel is marked
-	Midden not checked, no data
FL	Adult female Red Squirrel, lactating
F+'#'	Adult female Red Squirrel with "#" juveniles
RC	Radio-collared Red Squirrel (Arizona Game and Fish Study)

Appendix F: Measures of Spatial Distribution.

F-1. Crude Density

a) middens

b) squirrels

F-2. Local density and nearest neighbor distances of middens and squirrels.

Appendix F-1a: Crude density of red squirrel middens in each of the areas under study by the Monitoring Program. The size of each area is given in hectares (ha); densities are given in middens per hectare (mid/ha).

DATE	TRC 83.0 ha	TRN 24.4 ha	SFC 104.6 ha	SFN 128.9 ha
Dec 1995	0.65	1.15	1.14	0.88
Jan 1996	-	-	-	-
Feb 1996	0.65	1.19	1.16	0.92
Mar 1996	-	-	-	-
New Areas[3]	**83.6**	**24.4**	**101.1**	**128.9**
Apr 1996	0.65	1.23	1.21	0.92
Post-Burn Areas[4]	**49.1**	**24.4**	**76.1**	**128.9**
May 1996	-	-	-	-
Jun 1996	0.63	1.27	1.48	0.92
Jul 1996	-	-	-	-
Aug 1996	-	-	-	-
Sep 1996	0.67	1.35	1.48	0.94
Oct 1996	-	-	-	-
Nov 1996	-	-	-	-
Dec 1996	0.69	1.35	1.48	0.94

[1] - Data missing--census not made because of weather and snow conditions.

[2] The total number of occupied middens in September is unknown. The September censuses focused mainly on females, especially those with juveniles expected.

[3] These new areas are the result of more accurate GPS mapping.

[4] These new areas area the amount of habitat available for red squirrel use after the Clark Peak fire.

Appendix F-1b: Crude Density of red squirrels (including juveniles) in each of the monitored areas for December 1995 through December 1996 The size of each area is given in hectares (ha); densities are given in squirrels per hectare (sq/ha).

DATE	TRC 83.0 ha	TRN 24.4 ha	SFC 104.6 ha	SFN 128.9 ha
Dec 1995	0.42	0.61	1.00	0.64
Jan 1996	-	-	-	-
Feb 1996	0.39	0.66	1.01	0.65
Mar 1996	-	-	-	-
NEW AREAS[1]	**83.6 ha**	**24.4 ha**	**101.0 ha**	**128.9 ha**
Apr 1996	0.36	0.61	0.95	0.58
POST-BURN AREAS[2]	**49.1 ha**	**24.4 ha**	**76.1 ha**	**128.9 ha**
May 1996	-	-	-	-
June 1996	0.29	0.66	1.00	0.49
July 1996	-	-	-	-
Aug 1996	-	-	-	-
Sep 1996	0.37	0.66	0.80	0.46
Oct 1996	-	-	-	-
Nov 1996	-	-	-	-
Dec 1996	0.35	0.61	0.72	0.47

- No data - census not conducted

[1] These new areas are the result of more accurate GPS mapping.

[2] These new area figures are the amount of habitat available for red squirrel use after the Clark Peak Fire.

Appendix F-2: Local Density and Nearest Neighbor Distances of *middens* and *squirrels*.

TRC Area									
		Middens				Squirrels			
Month	# Mid	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 95	54	5.2	0.43	53.6	5.18	4.3	0.44	54.2	6.14
Jan 96	-	-	-	-	-	-	-	-	-
Feb 96	54	5.1	0.40	50.0	3.99	3.6	0.38	60.1	9.38
Mar 96	-	-	-	-	-	-	-	-	-
Apr 96	54	5.1	0.40	50.0	3.99	3.0	0.34	67.6	9.85
May 96	-	-	-	-	-	-	-	-	-
Jun 96	31	3.7	0.31	54.0	4.71	1.9	0.27	72.5	5.32
Jul 96	-	-	-	-	-	-	-	-	-
Aug 96	-	-	-	-	-	-	-	-	-
Sep 96	33	3.9	0.33	55.9	5.95	2.1	0.22	70.6	7.16
Oct 96	-	-	-	-	-	-	-	-	-
Nov 96	-	-	-	-	-	-	-	-	-
Dec 96	34	4.0	0.33	54.7	33.82	1.4	0.94	79.9	30.88

- Data missing, census not conducted.

Appendix F-2 (cont.)

TRN Area									
		Middens				Squirrels			
Month	# Mid	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 95	28	4.3	0.32	46.7	3.08	3.0	0.39	54.6	6.83
Jan 96	-	-	-	-	-	-	-	-	-
Feb 96	29	4.4	0.32	45.0	3.14	3.1	0.36	53.9	6.09
Mar 96	-	-	-	-	-	-	-	-	-
Apr 96	30	4.6	0.30	45.3	3.04	3.1	0.35	50.8	5.23
May 96	-	-	-	-	-	-	-	-	-
Jun 96	31	4.5	0.29	46.3	3.13	2.8	0.26	52.0	4.99
Jul 96	-	-	-	-	-	-	-	-	-
Aug 96	-	-	-	-	-	-	-	-	-
Sep 96	33	4.6	0.28	45.9	2.63	2.6	0.22	52.3	5.36
Oct 96	-	-	-	-	-	-	-	-	-
Nov 96	-	-	-	-	-	-	-	-	-
Dec 96	33	4.6	1.62	45.9	15.10	2.6	0.99	51.3	22.09

- Data missing, census not conducted.

Appendix F-2 (cont.)

SFC Area									
		Middens				Squirrels			
Month	# Mid	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 95	119	5.5	0.24	44.1	1.58	4.8	0.24	46.7	1.77
Jan 96	-	-	-	-	-	-	-	-	-
Feb 96	121	5.7	0.24	43.5	1.52	5.0	0.23	46.5	1.64
Mar 96	-	-	-	-	-	-	-	-	-
Apr 96	122	5.7	0.24	43.7	1.49	4.6	0.25	49.5	2.26
May 96	-	-	-	-	-	-	-	-	-
Jun 96	113	5.9	0.24	42.5	1.53	4.5	0.25	48.3	2.38
Jul 96	-	-	-	-	-	-	-	-	-
Aug 96	-	-	-	-	-	-	-	-	-
Sep 96	113	5.9	0.24	43.3	1.42	3.5	0.24	52.4	2.63
Oct 96	-	-	-	-	-	-	-	-	-
Nov 96	-	-	-	-	-	-	-	-	-
Dec 96	113	5.9	2.59	43.3	15.07	3.2	1.78	51.9	18.43

- Data missing, census not conducted.

Appendix F-2 (cont.)

SFN Area									
		Middens				Squirrels			
Month	# Mid	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 95	113	3.7	0.21	52.4	2.40	3.1	0.22	58.9	4.23
Jan 96	-	-	-	-	-	-	-	-	-
Feb 96	119	3.9	0.17	48.8	1.99	2.7	0.17	54.8	2.52
Mar 96	-	-	-	-	-	-	-	-	-
Apr 96	119	3.9	0.17	48.8	1.99	2.7	0.18	58.6	3.85
May 96	-	-	-	-	-	-	-	-	-
Jun 96	119	3.9	0.17	48.8	1.99	1.9	0.17	65.9	4.85
Jul 96	-	-	-	-	-	-	-	-	-
Aug 96	-	-	-	-	-	-	-	-	-
Sep 96	121	3.9	0.17	48.5	1.80	1.6	0.15	71.3	5.34
Oct 96	-	-	-	-	-	-	-	-	-
Nov 96	-	-	-	-	-	-	-	-	-
Dec 96	121	3.9	1.84	48.5	19.83	1.5	1.03	72.8	36.95

- Data missing, census not conducted.

Appendix F-2 (cont.)

All Areas Combined									
		Middens				Squirrels			
Month	# Mid	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	Mean Number w/i 100m	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 95	336	4.7	0.14	49.0	1.39	4.0	0.15	52.9	1.90
Jan 96	-	-	-	-	-	-	-	-	-
Feb 96	346	4.8	0.13	47.0	1.17	3.8	0.14	52.1	1.72
Mar 96	-	-	-	-	-	-	-	-	-
Apr 96	350	4.8	0.13	47.0	1.17	3.6	0.14	55.5	2.13
May 96	-	-	-	-	-	-	-	-	-
Jun 96	319	4.7	0.13	47.0	1.18	3.10	0.16	57.1	2.19
Jul 96	-	-	-	-	-	-	-	-	-
Aug 96	-	-	-	-	-	-	-	-	-
Sep 96	325	4.7	0.13	47.4	1.17	2.6	0.13	62.3	2.58
Oct 96	-	-	-	-	-	-	-	-	-
Nov 96	-	-	-	-	-	-	-	-	-
Dec 96	326[1]	4.8	2.34	47.3	21.00	2.2	1.56	63.9	31.20

- Data missing, census not conducted.

[1] This number includes off-area middens that are within 100 m of middens on the monitored areas

Appendix G. Reproductive success on the monitored areas, 1996.

G-1. Breeding chases seen on the monitored areas

G-2. Litters seen on the monitored areas

Appendix G-1 Breeding chases seen on the monitored areas.

DATE	MIDDEN	
Apr 24	4003	The resident female and three scrotal males are in the midden. All four squirrels chatter and bark. The male squirrels chase each other around the midden. One male sits in the same tree as the female.

Appendix G-2 Litters seen on the monitored areas.

DATE	MIDDEN	
April 22	1143	A lactating female was seen carrying a baby red squirrel to a hole in a downed log near the plaque tree.
June 16	4415	One juvenile was seen in the midden feeding on a cone.
June 16	4465	A lactating female was seen in the midden feeding on a spruce cone. Two juveniles were seen on the nest snag sitting near the opening.
June 17	3300	A juvenile was seen in the main snag. A lactating female and the juvenile barked in the midden.
June 28	3316	A lactating female entered the midden and began to feed on a spruce cone. A juvenile in a corkbark tree began to bark and a second juvenile was seen in the same tree. The female and one of the juveniles barked for about 10 minutes and then disappeared out of sight.
June 28	3325	Three juveniles were seen in a spruce tree moving through the branches. A lactating female was seen in midden 3389 collecting and feeding on cones. This female is a resident of midden 3325.
June 28	3369	A lactating female was seen feeding on a crumbled corkbark cone. Three juveniles were seen running on the ground, in the trees and on logs. One juvenile cached a piece of bark while another fed on spruce needles. One juvenile male began eating a spruce cone but stopped to run and play with the other juveniles.
June 29	4421	A post-lactating female was seen in the midden feeding on a spruce cone. A young of the year squirrel chatters and continues to feed on a spruce cone.

Appendix G-2 (cont.)

DATE	MIDDEN	
June 30	4415	One juvenile was seen moving in the trees and entering the nest snag. The juvenile emerged from the nest snag, collected a cone and fed.
June 30	4475	A juvenile male was seen moving about in the trees. A juvenile female was seen feeding on a spruce cone an barking at the observer. A post-lactating female entered the midden and was seen basking in a snag.
June 30	4469	Two older juveniles were seen sitting in a tree. One barked and chased birds while the other juvenile remained in the tree.
June 30	5123	Two older juveniles were seen in the midden. One juvenile was seen sitting in a corkbark tree while the other juvenile was seen running around the tree barking and chewing on branches.
July 10	3362	Marked female (-/Y) and one juvenile were seen in the midden.

Appendix H. Marked Squirrel Data

H-1. Squirrels with natural identifying marks and radio-collared squirrels.

H-2. Disappearances of marked squirrels.

H-3. Sightings of marked squirrels outside their midden.

H-4 Movements of marked squirrels to new middens.

H-5 Evidence of Marked Squirrels Using > 1 Midden

Appendix H-1. Squirrels with natural identifying marks and radio-collared squirrels.

Midden	Squirrel ID	Notes
1101	♂ - notch in right ear	seen in Sep
1119	♀ - short tail	seen in Apr and Feb
1130	♂ - notch in right ear	seen in Feb
1131	♀ - notch in both ears	seen in Feb
2208	♀ - large bump between eyes	seen in Feb
2208	♂ - notch in right ear	seen in Jun, Sep and Oct
3011	♂ - notch in left ear	seen in Sep
3020	♀ - notch in left ear	seen in Jul, Aug and Sep
3309	♂ - radio-collar and short tail	seen in Feb and Jun - Dec
3320	♀ - stort tail	seen in Jun, Aug, and Dec
3325[1]	♀ - short tail	seen in Aug - Oct
3325[1]	squirrel - short tail	seen in Dec
3326	♀ - notch in ear	seen in Sep
3340	♀ - notch in left ear	seen in May
3366	♂ - short tail	seen in Dec
3375	♂ - notch in left ear	seen in Jun
3387	♂ - hole in left ear	seen in Sep
3392	♂ - notch in right ear	seen in Apr, Aug, Sep & Oct

Appendix H-1 (cont.)

Midden	Squirrel ID	Notes
4420	S - notch in left ear	seen in Jun
4427	♂ - notch in right ear	seen in Sep
4428	♀ - notch in left ear	seen in Sep
4435	♂ - two notches in right ear	seen in Sep
4438[2]	♂ - short tail	seen in Jun and Sep
4438[2]	squirrel - short tail	seen in Dec
4470	♂ - notch in right ear	seen in Feb, Jun, Sep & Dec
5354	♂ - short tail	seen in Sep and Dec

[1] The squirrel seen in December in midden 3325 was assumed to be the female with a short tail seen in previous months.

[2] The squirrel seen in December in midden 4438 was assumed to be the male with a short tail seen in previous months.

Radio-collared squirrels

A female radio-collared on 4 Sep 1994 on the TRC area was seen eight times in 1995, each time at a different midden. She was seen at middens in the western portion of the TRC area from February through June. She was last seen at midden 5121 on 22 Oct 1995, and was never seen on the monitored areas in 1996.

A male radio-collared on 23 Aug 1995 southwest of Columbine Work Center was located on the SFC area in mid-September 1995. This squirrel was seen at several locations on the western portion of the SFC area. By October 1995, the male had established midden 3309 and remained there throughout 1995 and 1996.

Appendix H-2. Disappearances of marked squirrels. Ear-tags colors (left/right) are indicated by the capital letters in the Squirrel ID column. Information in parentheses in the Squirrel ID column indicates the original tag colors.

Month Last Seen	Capture Location	Squirrel ID	Notes
Feb 96	1106	Y/O ♀	Marked as a subadult on 12 Sep 1992. Last seen on the monitored areas 17 Feb 1996. This ♀ was seen on the areas for 53 months.
Feb 96	1108/1139	G/- (G/G) ♀	Marked as a subadult on 23 Sep 1992. Last seen on the monitored areas 17 Feb 1996. This ♀ was seen on the areas for 53 months. This midden was destroyed in the Clark Peak fire.
Feb 96	3392	R/- (R/R) ♂	Marked as a subadult on 22 Oct 1995. Last seen on the monitored areas 14 Feb 1996. This ♂ was seen on the monitored areas for 4 months. An unmarked ♂ now occupies the midden.
Jul 96	3362	-/Y (R/Y) ♀	Marked as a subadult on 10 Oct 1995. Last seen on the monitored areas Jul 10, 1996. This ♀ was seen on the monitored areas for 9 months. An unmarked subadult ♀ was occupying the midden by Sep. -/Y ♀ may have bequeathed her midden to one of her offspring.

Month Last Seen	Capture Location	Squirrel ID	Notes
Mar 96	3361	Y/B ♀	Marked as a subadult on 23 Oct 1995. Last seen on the monitored areas 15 Mar 1996. This ♀ was seen on the monitored areas for 5 months. An unmarked ♂ now occupies this midden.
Feb 96	3310	O/O ♂	Marked as a subadult on 18 Oct 1995. Last seen on the monitored areas on 14 Feb 1996. This ♂ was seen on the monitored areas for 4 months. This midden remained unoccupied after Mar 96.
Aug 96	3315	Y/- (Y/Y) ♀	Marked as a post lactating adult on 19 Oct 1995. Last seen on the monitored areas on 25 Aug 1996. This ♀ was seen on the monitored areas for 10 months. An unmarked ♀ appears to be the new resident.
Feb 96	3367	-/R (B/R) ♂	Marked as a subadult on 23 Oct 1995 at midden 3367. The ♂ was not seen for 2 months but was seen on 14 Feb in midden 3365. Last seen on the monitored areas on 15 Feb 1996. Midden 3365 is now occupied by W/- (W/R) ♂. B/R ♂ is assumed to have resided on the monitored areas for 4 months.

Appendix H-3. Sightings of marked squirrels outside their midden. Ear tag colors (left/right) are indicated by the capital letters in the Squirrel ID column.

Date	Squirrel ID	Location	Distance from own midden	Notes
26 Jan 96	3361 Y/B ♀	midden 3394	52 m	Sitting in a nest tree. Marked ♂ (-/-) chased her back to midden 3361.
17 Jun 96	3360 B/G ♂ (rip/metal)	midden 3310	32 m	Fed on a cone. Collected a cone and took it back to midden 3360.
29 Jul 96	3365 W/R (W/-) ♂	midden 3364	55 m	Collecting cones and taking them to midden 3365.
25 Aug 96	3315 Y/Y ♀ (Y/-)	midden 3339	50 m	fed on a cone.

Appendix H-4. Movements of marked squirrels to new middens.

Squirrel ID	Midden Moved from	Duration at Old Midden	Midden Status of **Old** Midden after Move	Midden Moved to	Duration at New Midden	Midden Status of **New** Midden before Move
-/R (B/R) ♂	3367	Oct 1995	unmarked ♂ from Dec 95 through Dec 96	3365	Feb 1996	unmarked ♂ from Jul - Dec 1995

Appendix H-5. Evidence of Marked Squirrels Using > 1 Midden

20 Jun 96	W/- (W/R) ♂, resident of midden 3365, was seen in midden 3020 (59 m from midden 3365) collecting cones, chasing an unmarked ♂ out of the midden, and feeding on a dried mushroom.
28 Jun 96	W/- (W/R) ♂, resident of midden 3365, seen in midden 3020 (59 m from midden 3365) feeding on Englemann spruce cones.
29 Jun 96	W/- (W/R) ♂, resident of midden 3365, seen in midden 3020 (59 m form midden 3365) chattering, squeaking, and chasing a naturally marked ♀ (notch in left ear) out of the midden as well as two jays.
29 Jul 96	W/- (W/R) ♂, resident of midden 3365, seen in midden 3020 (59 m from midden 3365) chattering in a tree.

Appendix I. Weather data for the monitored areas.

Appendix I-1.	Average Monthly Temperatures (°C)
Appendix I-2.	Total Monthly Precipitation (as rain) (mm).
Appendix I-3.	Monthly maxima, mimina and averages from snow poles in Spruce-Fir (SF) and Mixed Conifer (TR) habitats from locations in the forest (F) and in clearings (C).
Appendix I-4.	Minimum Wind Chill Temperatures (°C).
Appendix I-5.	Wind direction and speed.
Appendix I-6.	1996 Weather Data Available from Biology Camp Only (TRC).

Appendix I-1: Average Monthly Temperatures (°C)

	Avg. Monthly Temp.		Max. Monthly Temp.		Min Monthly Temp.	
	Biology Camp (TRC)	Emerald Peak (SFC)	Biology Camp (TRC)	Emerald Peak (SFC)	Biology Camp (TRC)	Emerald Peak (SFC)
Jan[1,2]	-0.8	-1.5	16.4	14.4	-13.4	-16.0
Feb	0.4	-1.0	16.3	12.0	-10.8	-13.0
Mar	1.4	-0.5	21.9	15.8	-9.2	-12.4
Apr	6.5	3.7	26.9	18.3	-7.2	-8.8
May	12.9	8.6	33.7	23.0	-2.4	-4.7
Jun	15.8	12.6	34.0	23.4	3.2	1.9
Jul	15.1[3]	12.1	32.3[3]	22.9	7.8[3]	3.4
Aug	13.7	10.8	29.8	23.5	7.7	2.2
Sep	9.8	7.0	23.9	17.9	0.2	-3.5
Oct	5.2	3.1	21.3	17.7	-10.3	-11.7
Nov	1.2	0.0	16.6	13.9	-12.1	-15.0
Dec	-0.5	-2.1	14.4	11.0	-12.0	-13.7

[1] data from January through April 24, 1996 were collected at 15 minute intervals. Data after April 24 were collected at 30 minute intervals.

[2] missing data: January 1, 1996 through midday January 5, 1996

[3] missing data: July 2-July 12, 1996

Appendix I-2. Total Monthly Precipitation (as rain) (mm).

	Biology Camp (TRC)	Emerald Peak (SFC)
Jan[1,2]	n/a	n/a
Feb	n/a	n/a
Mar	n/a	n/a
Apr	8.4	9.2
May	0.0	0.2
Jun	40.9	39.0
Jul	56.1[3]	93.8
Aug	78.9	105.4
Sep	124.1	115.0
Oct	4.8	2.4
Nov	n/a	n/a
Dec	n/a	n/a

[1] data from January through April 24, 1996 were collected at 15 minute intervals. Data after April 24 were collected at 30 minute intervals.
[2] missing data: January 1, 1996 through midday January 5, 1996
[3] missing data: July 2 - July 12, 1996
n/a not available; see snow pole data

Appendix I-3. Monthly maxima, mimina and averages from snow poles in Spruce-Fir (SF) and Mixed Conifer (TR) habitats from locations in the forest (F) and in clearings (C).

Month	Habitat	Location	Avg. snow depth (cm)	Max. snow depth (cm)	Min. snow depth (cm)
Nov 1995	SF	C	3	10	0
Nov 1995	SF	F	1	2	0
Nov 1995	TR	C	0	0	0
Nov 1995	TR	F	0	0	0
Dec 1995	SF	C	12	28	2
Dec 1995	SF	F	6	12	0
Dec 1995	TR	C	8	18	0
Dec 1995	TR	F	6	14	0
Jan 1996	SF	C	14	29	1
Jan 1996	SF	F	6	12	0
Jan 1996	TR	C	10	14	0
Jan 1996	TR	F	6	13	0
Feb 1996	SF	C	38	66	16
Feb 1996	SF	F	22	30	15
Feb 1996	TR	C	26	37	18
Feb 1996	TR	F	21	28	16
Mar 1996	SF	C	40	83	0
Mar 1996	SF	F	34	47	14
Mar 1996	TR	C	27	52	0
Mar 1996	TR	F	19	38	0

Appendix I-3 (cont.):

Month	Habitat	Location	Avg. snow depth (cm)	Max. snow depth (cm)	Min. snow depth (cm)
Apr 1996	SF	C	7	33	0
Apr 1996	SF	F	13	35	0
Apr 1996	TR	C	2	11	0
Apr 1996	TR	F	2	11	0
Nov 1996	SF	C	13	30	0
Nov 1996	SF	F	7	19	0
Nov 1996	TR	C	0	0	0
Nov 1996	TR	F	0	0	0
Dec 1996	SF	C	42	58	28
Dec 1996	SF	F	22	31	0
Dec 1996	TR	C	29	41	22
Dec 1996	TR	F	20	25	16

Appendix I-4: Minimum Wind Chill Temperatures (°C).

	Biology Camp (TRC)	Emerald Peak (SFC)
Jan[1,2]	-14.0	-19.0
Feb	-14.0	-13.0
Mar	-15.6	-16.2
Apr	-8.9	-10.3
May	-2.4	-5.0
Jun	3.2	1.2
Jul	7.8[3]	3.4
Aug	7.7	2.2
Sep	0.2	-3.5
Oct	-11.0	-12.2
Nov	-12.6	-14.9
Dec	-11.7	-13.7

[1] data from January through April 24, 1996 were collected at 15 minute intervals. Data after April 24 were collected at 30 minute intervals.

[2] missing data: January 1, 1996 through midday January 5, 1996

[3] missing data: July 2 - July 12, 1996

Appendix I-5: Wind direction and speed.

	Most Common Wind Direction		Max. Wind Speed (m/sec)		Max. Speed of a Single Wind Gust (m/sec)	
	Biology Camp (TRC)	Emerald Peak (SFC)	Biology Camp (TRC)	Emerald Peak (SFC)	Biology Camp (TRC)	Emerald Peak (SFC)
Jan[1,2]	N	W-NW	3.6	4.9	15.2	19.7
Feb	S	W-NW	3.1	4.5	12.1	12.5
Mar	S	W-NW	3.6	4.0	14.3	15.2
Apr	n/a	W-NW	3.6	3.1	13.4	11.2
May	S	W-NW	2.2	2.7	11.2	10.7
Jun	N	W-NW	1.8	4.5	8.0	10.0
Jul	N [3]	N-NW	2.7[3]	2.7	8.0[3]	7.6
Aug	N	SE	2.7	3.1	9.8	9.4
Sep	S	SE	1.8	3.1	9.8	12.1
Oct	S	SE	3.6	3.6	17.0	12.5
Nov	S	W-NW	3.1	3.6	12.1	10.7
Dec	N	W	3.6	4.0	11.2	13.9

[1] data from January through April 24, 1996 were collected at 15 minute intervals. Data after April 24 were collected at 30 minute intervals.

[2] missing data: January 1, 1996 through midday January 5, 1996

[3] missing data: July 2 - July 12, 1996

Appendix I-6. 1996 Weather Data Available from Biology Camp Only (TRC).

	Minimum Barometric Pressure (mbar)	Average Relative Humidity (percent)	Maximum Relative Humidity (percent)	Minimum Relative Humidity (percent)	Maximum Dew Point (degrees Celcius)	Minimum Dew Point (degrees Celcius)
Jan[1,2]	529.7	39.4	91	8	-0.4	-34.0
Feb	530.2	61.3	93	17	1.9	-22.0
Mar	531.8	44.0	91	9	-1.6	-29.6
Apr	518.4	n/a	88	9	0.5	-22.1
May	514.3	28.0	80	8	2.7	-18.4
Jun	521.0	40.1	91	9	12.6	-16.2
Jul[3]	521.9	67.0	98	27	14.9	4.1
Aug	519.6	70.8	97	20	14.6	-1.4
Sep	514.9	75.0	98	33	12.9	-4.1
Oct	509.6	60.0	96	7	9.3	-29.9
Nov	510.4	50.7	93	11	0.3	-23.2
Dec	516.9	41.5	94	8	1.1	-33.9

[1] data from January through April 24, 1996 were collected at 15 minute intervals. Data after April 24 were collected at 30 minute intervals.

[2] missing data: January 1, 1996 through midday January 5, 1996

[3] missing data: July 2 - July 12, 1996

n/a not available

Appendix J: Middens Removed from Regular Censusing (after December 1996).

Appendix J-1. Middens with low occupancy to be removed from regular censusing after December 1996.

Appendix J-2: Middens burned in the Clark Peak fire (April 1996) to be removed from regular censusing.

Appendix J-1. Middens with low occupancy to be removed from regular censusing after December 1996. Middens to be removed must meet the following criteria: 1) The midden must have been censused for at least 36 months, 2) the midden must have been occupied less than 10% of the months censused, and 3) the midden was not occupied in 1996.

Midden	Months Known	Months Censused	Months Occupied	Percent Occupied	Occupied in 1996?
1114	87	65	2	3.08%	No
1151	62	43	2	4.65%	No
2213	76	54	5	9.26%	No
2222	62	42	4	9.52%	No
3352	92	69	0	0.00%	No
3357	92	71	1	1.41%	No
4425	89	65	0	0.00%	No
4434	84	61	4	6.56%	No
4440	72	48	0	0.00%	No
4446	92	65	1	1.54%	No
4448	92	39	0	0.00%	No
4451	92	65	2	3.08%	No
4453	92	66	0	0.00%	No
4455	92	65	0	0.00%	No
4456	92	66	1	1.52%	No
4458	92	65	3	4.62%	No
4459	92	65	0	0.00%	No
4468	92	65	1	1.54%	No
4479	74	51	3	5.88%	No
4480	74	51	3	5.88%	No
4483	92	62	2	3.23%	No
4485	92	65	2	3.08%	No
4486	92	66	5	7.58%	No
4487	92	65	3	4.62%	No
4493	63	42	0	0.00%	No

Appendix J-2: Middens burned in the Clark Peak fire (April 1996) to be removed from regular censusing.

Midden	Damage Description
1105	completely burned
1107	completely burned
1109	completely burned
1110	completely burned
1117	completely burned
1119	completely burned
1120	completely burned
1122	completely burned
1123	completely burned
1124	completely burned
1125	completely burned
1130	almost completely burned
1135	completely burned, close to unburned area, ♂ squirrel seen in midden - June/July
1136	completely burned
1137	completely burned
1139	completely burned
1140	completely burned
1141	completely burned
1142	completely burned
1143	completely burned
1148	completely burned
1152	completely burned - ♀ squirrel seen in midden in early June
1159	completely burned
3004	completely burned
3012	intense ground fire, trees scorched
3015	completely burned
3016	completely burned
3017	completely burned
3018	completely burned
3021	completely burned
3358	completely burned
3359	intense ground fire, trees scorched
3384	completely burned