

THE UNIVERSITY OF  
**ARIZONA**  
MT. GRAHAM RED SQUIRREL MONITORING PROGRAM

**Annual Report  
for  
2003**

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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 2003. The MGIO is located along a ridge extending westward from Hawk Peak in the Graham (Pinaleno) Mountains of southeastern Arizona. In 2003, 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). Construction continued on the Large Binocular Telescope (LBT) throughout 2003, with mainly interior building work.

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 Mt. Graham red squirrel. Four areas encompassing 337.9 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) (83.6 ha), TR habitat non-construction (TRN) (24.4 ha), SF habitat construction (SFC) (101.0 ha) and SF habitat non-construction (SFN) (128.9 ha). After the Clark Peak fire in spring 1996, the amount of habitat available for use by red squirrels was reduced to 49.1 ha on the TRC area and 76.1 on the SFC area. The amount of available habitat on the TRN and SFN areas remained unchanged. The total amount of available habitat on all four monitored after 1996 was 278.5 ha. In 2000, the size of the four monitored areas was further refined through GPS mapping: TRC - 51.1ha, TRN - 21.0 ha, SFC - 76.0 ha, and SFN - 104.4, for a total of 252.5ha.

A census of all middens within the monitored areas was conducted in March, June, September, and December. In addition, middens within 100 m of the LBT site or the access road were censused during other months: January, April, August, October and November. Census 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. Conifer seeds and mushrooms (epigeous or above-ground fungi) were collected at all 28 sites (Figure 1).

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

The Monitoring Program has developed and maintains a database using Global Positioning System (GPS) and Geographic Information System (GIS) applications. By the end of 2003, all of the major features on the monitored areas were mapped using GPS, including middens, food resource plots, roads, trails, and MGIO boundaries.

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. No part of this report may be used or reproduced in any form without the written permission of the Monitoring Program Supervisor.

Percentages are rounded to the nearest whole number, therefore totals may be slightly more or less than 100%.

## 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 circular area 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 known midden sites are marked with numbered metal tags, and black and orange striped flagging. During censuses or other monitoring duties, new activity areas that have the potential to become new middens are often located. Feeding sign, caching and squirrels are seen at these areas. These areas are assigned a temporary number and are assessed for improved sign and the presence of a squirrel during the next quarterly census. If conditions warrant, an activity area will be upgraded to a midden and added to the regular quarterly censuses. If an activity area shows no improvement in the two quarterly censuses following initial location, it will be removed.

At the end of each calendar year, a list of middens to be removed from regular censusing is compiled. 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 is removed from the regular censusing list. If any of these middens become re-occupied, they are added back to the regular censusing list. In 2003, because there were large number of removed middens in some areas as a result of insect damage, we began visiting all removed middens during each census, instead of only in December as was done previously. This change was made so as not to leave large parts of the monitored areas unvisited for an entire year. Removed middens, if still unoccupied, are simply checked off a tally sheet, while complete notes are taken on middens considered to be in the regular census.

All statistical analyses were conducted using standard tests found in SAS and/or Minitab statistical software. 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. In 2002, seed production was estimated from 28 seedfall plots distributed among the monitored areas (Figure 1).



Three 0.25 m<sup>2</sup> seed traps were randomly placed within a 10 m x 10 m plot at each location. Seeds from the 2002 crop were collected from the seed traps in Jun 2003. The conifer seeds contained in each trap were separated by species and individually tested (squashed) to determine the proportion of seeds that were 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.

### Mushroom Production

As in previous years, mushrooms were collected from plots 1 m by 100 m (0.01 ha) at two week intervals, from July through October. Mushrooms were collected from a total of 28 plots including the four plots added on the TRC and SFC in late 1996 (after the Clark Peak fire). In 2003, mushrooms were again collected from north-south oriented plots, instead of east-west as in 2001 and years prior . In 2001, we collected mushrooms from both east-west and north-south plots. There were no significant differences in weight, number, or diversity of mushrooms between the two orientations. It was decided to “rest” the east-west plots for several years. 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. For most genera, dry weight was calculated by multiplying the wet weight by a wet weight/dry weight ratio determined from previous samples on Mt. Graham. Dry weights were still measured for those genera with small numbers of specimens previously collected (<50).

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 data. For comparison, the previous year's seed and mushroom 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 March, June, September, and December 2003, all middens were visited at least once to determine occupancy. In addition, middens within 100 m of construction activity or the access road were censused during other months: January, April, August, October, and November. 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 on subsequent midden visits to observe the squirrel and to determine its sex, age, and reproductive condition. In 2003, most of the animals on or near the monitored areas were ear-tagged and many were fitted with radio collars. This added

additional verification to the census data. Very occasionally during winter months, visual verification was not practical, and determination of occupancy 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 possibly 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 possibly occupied when red squirrel sign was found but the sign was insufficient to clearly indicate occupancy. Possibly 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 June and December.

### Overwinter Survival

Overwinter survival was estimated for squirrels in the monitored areas. During a complete census in December 2002, the number of occupied middens and the identity of resident squirrels were determined (many were ear-tagged and radio-collared). The December occupancy was then compared to occupancy for June 2003. For unmarked animals, 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 June. In addition, if the midden was listed as occupied based on sign or a squirrel of unknown sex was seen, this was also counted as a survival. For marked squirrels, survival was generally known with a fair degree of certainty using available trapping and telemetry information.

### 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) is 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 were determined for each midden and squirrel from the mapped coordinates and 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 2003, the breeding condition of adult male and female squirrels, and litter activity was recorded when observed. By examining the squirrel's condition through trapping efforts or binoculars, the reproductive status of a female was determined to be non-lactating, reproductive (vulva visibly swollen or appearance of pregnancy), lactating, or post-lactating. The reproductive status of male squirrels was also determined during trapping or visual assessment and was recorded as "testes non-scrotal" (non-reproductive) or "testes scrotal" (sexually active).

### Trapping and Marking

In accordance with Federal Fish and Wildlife Permit #TE041875-1, using accepted methods (Koprowski 2002) red squirrels are trapped using Tomahawk wire-mesh box-type live traps, baited with peanuts, peanut butter, apples, mushrooms, or cones. Once captured, red squirrels are transferred to a cloth-handling cone for tagging and morphological measurements. Squirrels are tagged with small numbered metal ear-tags threaded with colored plastic washers for easy distance identification. Squirrels are normally released within 2-3 minutes of transfer to the cloth-handling bag and are observed for several minutes to ensure good condition.

## Mapping

All middens and other physical features on the monitored areas have been previously mapped using GPS with an accuracy of  $\pm 5$ m. Universal Transverse Mercator (UTM) coordinates from the GPS files were used to compute local densities, nearest neighbor distances, and distance to construction. New GPS data (nests, habitat plots, etc.) were collected using a GeoExplorer II 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 GPS locations were based on an average from a minimum of 200 three-dimensional data points. Locations were differentially corrected using base station (Continuously Operating Reference Station, CORS-COT1, Tucson, Arizona). 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 is located along the abandoned Forest Service road north of Emerald Peak on the SFC area; the other is located at the Biology Camp on the TRC area. The stations record air temperature (high, low, and average), wind speed, wind direction, rainfall, relative humidity and barometric pressure. Data were collected at 30 minute intervals until September 2000, when the stations were recalibrated to record at 60 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.

## RESULTS

### Red Squirrel Food Resources

#### 2002 Conifer Seed Production

The total 2002 seed crop was the second lowest seen on the monitored since data collection began in 1993. While numbers were low for all the sampled species, corkbark fir was the most abundant in 2002 (Table 2, Figures 2a-c, Appendix A).

When comparing the 2002 seed crop to previous years by individual species, the corkbark fir crop was the fourth lowest ever seen, the Douglas-fir crop was the third lowest, and the Engelmann spruce crop was the second lowest.

The 2002 overall seed crop was 321 times less than the seed crop seen in 2001, which was the highest since data collection began in 1993 (Table 2, Figures 2a-c, Appendix A).

#### 2003 Mushroom Production

Overall annual mean mushroom production in 2003 was approximately 40% lower than seen in 2002, and was the lowest since data collection began in 1994. There were decreases in the TR habitat and slight increases in the SF habitat in 2003 as compared to 2002 (Figure 3). In 2003, there were no differences in annual production ( $\bar{x}$  wet weight) within the TR habitat. The production on the SFC area was significantly greater than the SFN area (Table 3).

On the TRC area, three genera, *Cortinarius*, *Lycoperdon*, and *Russula*, accounted for 97% of production. On the TRN area, *Cortinarius*, *Auricularia*, and *Pholiota* accounted for 79% of total production. *Russula*, *Lycoperdon*, and *Cortinarius* accounted for 94% of the production on the SFC area. On the SFN area, *Cortinarius*, *Russula*, and *Lycoperdon* accounted for 96% of the total production (Table 4).

## Population Biology

### Midden Occupancy

Four quarterly censuses (Mar, Jun, Sep, and Dec) of all middens on or near the monitored areas were made in 2003 (Appendix B-1). In addition, the 13 middens (by Dec 03) within 100 m of the access road or construction were censused during other months (Appendix C).

From December 2002 to December 2003, the number of red squirrels on the monitored areas increased from 21 to 36, a 36% increase. On the TRC area, the highest number of squirrels (7 Ad + 7J) was seen in Spetember 2003, and the lowest number was 9 squirrels seen in June. June was the month with the lowest number of squirrels (2 Ad) on the TRN area. The highest squirrel numbers (6Ad) on the TRN area were seen in December. The highest number of squirrels on the SFC area was seen in December (8 Ad) with the lowest (2 Ad) seen in March and June. On the SFN area, the highest number of squirrels (11 Ad) was seen in December and the lowest (0 squirrels) was seen in June (Figure 4, Appendix B-1,C,D,E).

No newly established middens were found in 2003. Ten middens in the SF habitat, previously removed from regular censusing because of low occupancy, became reoccupied (Table 5). As a result, the proportion of middens in the SF habitat increased slightly. The proportion of squirrels, as a part of the total population on the monitored areas, decreased from June to December in the TR habitat, and increased in the SF habitat (Table 6).

In June 2003, the proportion of middens occupied on the TRC area was significantly greater than on the TRN area. There were no significant differences in the proportion of middens occupied *within* the SF habitat in June. In December 2003, there were no significant differences within either habitat (Table 7).

The average distance to construction of occupied middens and unoccupied middens was not significantly different on either the TRC or SFC areas for June and December 2003. On the TRC area in June, occupied middens were slightly closer to construction than unoccupied middens, and in December, unoccupied middens were slightly closer to construction. On the SFC area, in both June and December, occupied middens were slightly farther from construction than unoccupied middens (Table 8).

### Overwinter Survival

There were no significant differences in the number of squirrels that survived the winter of 2002-2003 among all the monitored areas (Table 9). The average proportion of survival was 61% in the TR habitat and 33% in the SF habitat. For comparison, the average proportion of survival from the previous winter (2001-2002) was 42% in the TR habitat and 63% in the SF habitat.

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. However, this potential overestimate is becoming less likely as more squirrels on the monitored areas are ear-tagged and radio-collared for unique identification.

### 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 5). Between December 2002 and December 2003, the crude density of *middens* decreased slightly on all areas due to the removal of low occupancy middens from regular censusing (Figure 5, Appendix F-1a).

The crude density of *squirrels* on all areas increased from December 2002 to December 2003. The TRC was the exception, with a slight decrease seen in December 2003 (Figure 5, Appendix F1-b).

### Local Density

The December 2003 overall mean local density ( $\bar{x}$  LD) of *middens* was slightly lower (3.7), than in December 2002 (4.3). There were significant differences in the local density of middens among the four areas. The SFN area had the lowest  $\bar{x}$  LD (1.3), and the TRC area had the highest (5.6) (Table 10, Figure 6, Appendix F-2).

The mean  $\bar{x}$  LD of *squirrels* (occupied middens) on all areas in December 2003 was 0.9, which is a decrease from 1.8 in December 2002. There were statistical differences in the  $\bar{x}$  LD of *squirrels* among all of the monitored areas. The SFN area had the lowest  $\bar{x}$  LD (0.4) and the TRC had the highest (1.8) (Table 10, Figure 6, Appendix F-2).

### Nearest Neighbor Distance

The overall  $\bar{x}$  NND of *middens* increased slightly from December 2002 to December 2003 (56.4 to 58.2 m). The  $\bar{x}$  NND in the SF habitat was significantly longer than in the TR habitat in December 2003 (Table 11, Figure 7, Appendix F-2).

The  $\bar{x}$  NND of *squirrels* (occupied middens) for all areas decreased from 126.7 m in December 2002 to 117.9 m in December 2003. There were no significant differences in  $\bar{x}$  NND among all the areas in December 2003 (Table 11, Figure 7, Appendix F-2).

## Reproductive Activity and Success

Six breeding chases were observed in 2003, from April through June. Three chases were seen on the monitored areas, and three were seen just outside the areas, but involved marked squirrels who were residents at middens on the monitored areas (Appendix G-1). Based on information from census and trapping records, a majority of the resident adult males were scrotal throughout the year. The peak breeding period, based on testes length, was March through July (Appendix G-3b).

The earliest a lactating female was observed was 2 July on the TRC area and the latest was on 11 September, also on the TRC area. During the June census, of the 11 adult females (including nearby off-area middens) identified as residents, 6 were reproductive and 1 was lactating. By September, 7 of the resident females were classified as lactating, and 3 were classified as post-lactating (Appendix G-3a).

Direct evidence of 5 litters (19 juveniles) was seen on or near the monitored areas during censuses or other activities. The earliest litters were seen at the end of August in the TR habitat, and the latest was seen in early September on the SFC area (Appendix G-3c).

For reproductive status and age information, it must be noted that the numbers do not necessarily represent the residents of the same middens from census to census. This information is provided only for a general picture of the reproductive and age status of the squirrels on or near the monitored areas.

## Trapping and Marking

### Marked Squirrels

By the end of 2003, nearly all the residents on or near the monitored areas were fitted with colored ear tags and most of these were radio-collared (Appendix B). The exception was the SFN areas, where none of the new resident animals were yet marked. In addition, 5 juveniles were caught while still at natal middens and fitted with small numbered metal ear tags to aid in the collection of dispersal information. By the end of 2003, three of these animals (all recaptured and fitted with colored ear tags) were independently living at middens on the monitored areas (Appendix G-3a).

## Mapping

No significant changes in maps of the monitored areas were made in 2003, as all major features (middens, roads, trails, construction areas, etc.) have been mapped in previous years. Any new nests or habitat plots were GPS located and added to databases and maps.



## Weather Data

Weather data were collected nearly continuously in 2003 from two weather stations located at the biology camp (TR habitat) and near Emerald Peak (SF habitat). The maximum temperature recorded was 27.6°C in July at the biology camp and the minimum temperature recorded was -17.1°C in December on Emerald Peak. The maximum average monthly temperature was 15.8°C in July at the biology camp and the minimum average monthly temperature was -3.8°C in February on Emerald Peak. (Figure 8, Appendix H-1). The maximum total monthly rainfall was recorded in July, with 67.6 mm at Emerald Peak. June was the driest month with 2.0 mm recorded at the biology camp and 1.0 mm on Emerald Peak (Figure 9, Appendix H-1). Snow depth was recorded from the eight pairs of snow poles on the monitored areas. The average accumulated snow depth from December 2002 through April 2003 ranged from 0 cm to 104.8 cm (Figure 10, Appendix H-2). For comparison, average accumulated snow depths for December - March in 2001-2002 ranged from 0 cm to 30.7 cm, and in November - May 2000-2001, depths ranged from 0.0 cm to 132.5 cm. Data on wind chill temperatures, wind direction and speed, humidity, and barometric pressure were also collected (Appendix H-1).

## Insect Outbreaks on the Monitored Areas

Infestations of bark beetles (*Drycoetes confuses* and *Dendroctonus rufipennis*) continued on parts of the monitored areas in 2003, although to a lesser degree than in previous years. Spruce aphid (*Elatobium abietinum*) were seen, but in much reduced numbers. For a detailed report on forest health and continuing research on the insect infestations, please contact the USFS Southwestern Region Entomology and Pathology Office in Flagstaff, AZ. [http://www.for.nau.edu/usfs/r3\\_fpm/](http://www.for.nau.edu/usfs/r3_fpm/).

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

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

Table 2. Mean filled conifer seed production, 2002. The percent column represents the proportion of each seed species on an individual area.

Area/Habitat	n	<u>Corkbark fir</u>		<u>Douglas-fir</u>		<u>Engelmann spruce</u>	
		$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%
TRC	5	10.64	26.7	18.56	46.6	8.00	20.1
TRN	4	6.60	100.0	0.00	0.0	0.00	0.0
SFC	7	18.97	83.4	0.00	0.0	3.77	16.6
SFN <sup>1</sup>	12	0.00	0.0	0.00	0.0	4.43	100.0
TR Habitat	9	8.84	35.3	10.31	41.1	4.44	17.7
SF Habitat	19	6.99	62.5	0.00	0.0	4.19	37.5

Table 3. Mean annual mushroom production, 2003.

Area/Habitat	n	$\bar{x}$ Wet weight $\pm$ se (Kg/ha)	$\bar{x}$ Dry weight $\pm$ se (Kg/ha)
TRC	5	4.90 $\pm$ 3.92	0.46 $\pm$ 0.361
TRN	4	13.74 $\pm$ 4.87	1.33 $\pm$ 0.458
SFC	7	15.44 $\pm$ 3.854	1.72 $\pm$ 0.411
SFN	12	4.90 $\pm$ 1.962	0.46 $\pm$ 0.175
TR Habitat	9	8.83 $\pm$ 3.26	0.85 $\pm$ 0.307
SF Habitat	19	8.73 $\pm$ 2.183	0.92 $\pm$ 0.231

Wilcoxon Test within TR:Wet Weight  $Z = 1.3472$   $P = 0.1779$ Dry Weight  $Z = 1.3472$   $P = 0.1779$ Wilcoxon Test within SF:Wet Weight  $Z = 2.4193$   $P = \mathbf{0.0155}$ Dry Weight  $Z = 2.6740$   $P = \mathbf{0.0075}$

Table 4. Mean annual mushroom production (wet weight Kg/ha) of selected mushroom genera known to be food resources for red squirrels, 2003. The proportions of the three most available genera on each area are in bold.

Genus	<u>TRC</u>		<u>TRN</u>		<u>SFC</u>		<u>SFN</u>	
	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%	$\bar{x}$ Kg/ha	%
<i>Amanita</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Auricularia</i>	0.00	0.0	2.85	<b>20.8</b>	0.02	0.1	<0.01	<0.01
<i>Boletus</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Clavaria</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Clitocybe</i>	0.15	3.0	0.86	6.2	0.35	2.3	0.20	4.1
<i>Cortinarius</i>	3.82	<b>77.9</b>	6.69	<b>48.7</b>	1.07	<b>6.9</b>	3.21	<b>66.6</b>
Gastroid sp.	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Hydnum</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Lactarius</i>	0.00	0.0	0.34	2.5	0.57	3.7	0.00	0.0
<i>Leccinum</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Lycoperdon</i>	0.70	<b>14.3</b>	0.61	4.4	2.98	<b>19.3</b>	0.16	<b>3.4</b>
<i>Pholiota</i>	0.00	0.0	1.26	<b>9.2</b>	0.00	0.0	0.00	0.0
<i>Ramaria</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
<i>Russula</i>	0.23	<b>4.8</b>	1.12	8.1	10.45	<b>67.7</b>	1.25	<b>25.8</b>
<i>Suillus</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Total	4.90		13.74		15.44		4.82	

Table 5. Number and discovery status of red squirrel middens on each of the monitored areas, 2002-2003.

		Midden Status				
Year	Area	Old	Newly Found	Newly Established	Re-Occupied <sup>2</sup>	Total
2002	TRC	39	0	1	0	40
	TRN	41	0	0	0	41
	SFC	62	0	0	0	62
	SFN	37	0	0	0	37
	Total	179	0	1	0	180
2003	TRC	37 <sup>1</sup>	0	0	0	37
	TRN	35 <sup>1</sup>	0	0	0	35
	SFC	33 <sup>1</sup>	0	0	3	36
	SFN	25 <sup>1</sup>	0	0	7	32
	Total	130 <sup>1</sup>	0	0	10	140

- 1 The difference in the number of middens from the end of 2002 to the beginning of 2003 reflects middens removed from regular censusing after the December 2002 census due to low occupancy.
- 2 These are middens that were previously removed from regular censusing due to low occupancy, but have become re-occupied.

Table 6. Proportion of the total area, total number of middens, and total number of squirrels<sup>1</sup> found on each of the monitored areas, 2002-2003.

	<u>Area</u>		<u>Jun 2002</u>				<u>Dec 2002</u>			
			<u>Middens</u>		<u>Squirrels<sup>1</sup></u>		<u>Middens</u>		<u>Squirrels<sup>1</sup></u>	
	<u>ha</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>
TRC	51.1	20	40	22	22	65	40	22	14	67
TRN	21.0	8	41	23	6	18	41	23	4	19
SFC	76.0	30	62	34	4	12	62	34	2	10
SFN	104.4	41	37	21	2	6	37	21	1	5
Total	252.5		180		34		180 <sup>3</sup>		21	

	<u>Area</u>		<u>Jun 2003</u>				<u>Dec 2003</u>			
			<u>Middens</u>		<u>Squirrels<sup>1</sup></u>		<u>Middens</u>		<u>Squirrels<sup>1</sup></u>	
	<u>ha</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>	<u>N</u>	<u>%<sup>2</sup></u>
TRC	51.1	20	37	29	9	69	37	26	11	31
TRN	21.0	8	35	27	2	15	35	25	6	17
SFC	76.0	30	33	25	2	15	36	26	8	22
SFN	104.4	41	25	19	0	0	32	23	11	31
Total	252.5		130 <sup>3</sup>		13		140		36	

- 1 Juveniles living with their mothers are not counted in the number of squirrels. Number of squirrels is equal to the number of occupied middens.
- 2 All percentages are rounded to the nearest whole number.
- 3 The difference in the number of middens from December 2002 to June 2003 reflects middens removed from regular censusing due to low occupancy after the December 2002 census.



Table 7. Number and percent of available middens occupied, 2003.

Area/Habitat	<u>June</u>			<u>December</u>		
	# middens	# occupied	% occ	# middens	# occupied	% occ
TRC	37	9	24	37	11	30
TRN	35	2	6	35	6	17
SFC	33	2	6	36	8	22
SFN	25	0	0	32	11	34
TR Habitat	72	11	15	72	17	24
SF Habitat	58	2	4	68	19	28
TR + SF	130	13	10	140	36	26

**Chi Square:****JUNE**

within TR  $X^2=4.813$  df=1 ***P=0.028***

**Fisher's Exact Test:\***

within SF *P=0.501*

**DECEMBER**

within TR  $X^2=1.579$  df=1 *P=0.209*

within SF  $X^2=1.242$  df=1 *P=0.265*

\* Fisher's Exact Test was used to analyze data for the SF area in June due to small sample sizes.

Table 8. Mean distance from construction to occupied and unoccupied middens on the TRC and SFC areas, June and December 2003.

Area	Midden Status	n	<u>June</u>	<u>December</u>	
			$\bar{x} \pm se$ (m)	n	$\bar{x} \pm se$ (m)
TRC	Occupied	9	199.1 $\pm$ 25.7	11	217.8 $\pm$ 16.9
	Unoccupied	28	218.5 $\pm$ 9.61	26	212.1 $\pm$ 11.6
SFC	Occupied	2	177.5 $\pm$ 33.5	8	173.0 $\pm$ 31.2
	Unoccupied	31	144.2 $\pm$ 12.7	28	149.6 $\pm$ 13.3

**ANOVA:**

**JUNE**

TRC                      F = 0.76              df = 1              P = 0.388

SFC                      F = 0.43              df = 1              P = 0.519

**DECEMBER**

TRC                      F = 0.07              df = 1              P = 0.787

SFC                      F = 0.62              df = 1              P = 0.438

Table 9. Overwinter survival of red squirrels on the monitored areas, 2002-2003.

Area/Habitat	Number of	Number of	% survival
	Squirrels	Squirrels Surviving	
	Dec 2002	Jun 2003	
TRC	14	9	64.3
TRN	4	2	50.0
SFC	2	1	50.0
SFN	1	0	0
TR Habitat	18	11	61.1
SF Habitat	3	1	33.3

Fisher Exact Test\*

within TR P = 0.652

within SFC P = 0.667

\* Fisher Exact test was used for this analysis due to the small sample size in these areas

Table 10. Mean Local Density of middens and red squirrels (occupied middens) on the monitored areas, 2002 and 2003.

Area/Habitat	December 2002				December 2003			
	Middens		Squirrels		Middens		Squirrels <sup>1</sup>	
	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$
TRC	40	5.9 ± 0.44 <sup>a</sup>	14	2.3 ± 0.38 <sup>a</sup>	37	5.6 ± 0.47 <sup>a</sup>	11	1.8 ± 0.30
TRN	41	6.5 ± 0.28 <sup>a</sup>	4	1.3 ± 0.63 <sup>a</sup>	35	5.5 ± 0.30 <sup>a</sup>	6	0.7 ± 0.33 <sup>ab</sup>
SFC	62	3.5 ± 0.21	2	0 <sup>a</sup>	36	2.3 ± 0.19	8	0.6 ± 0.26 <sup>ac</sup>
SFN	37	1.3 ± 0.18	1	0 <sup>a</sup>	32	1.3 ± 0.16	11	0.4 ± 0.15 <sup>bc</sup>
TR Habitat	81	6.2 ± 0.26	18	2.1 ± 0.34	72	5.5 ± 0.28	17	1.4 ± 0.26
SF Habitat	99	2.7 ± 0.18	3	0	68	1.8 ± 0.14	19	0.5 ± 0.14
TOTAL <sup>1</sup>	180	4.3 ± 0.2	21	1.8 ± 0.3	140	3.7 ± 0.22	36	0.9 ± 0.16
<b>ANOVA:</b>								
<b>LD of Middens</b>								
among all areas	F=62.29		df=3	P<0.0001	H = 80.32		df=3	P = <0.0001
<b>LD of Squirrels</b>								
among all areas	F=2.55		df=3	P=0.09	H = 12.52		df=3	P = 0.006

a,b,c Means within the same category, with the same letter(s), within the same year, are not significantly different.

1 Includes only middens on the monitored areas.

Table 11. Mean Nearest Neighbor Distance of middens and red squirrels (occupied middens) on the monitored areas, 2002 and 2003.

Area/Habitat	December 2002				December 2003			
	Middens		Squirrels <sup>1</sup>		Middens		Squirrels <sup>1</sup>	
	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$
TRC	40	41.5 ± 2.63 <sup>a</sup>	14	62.2 ± 7.75 <sup>a</sup>	37	42.3 ± 2.86 <sup>a</sup>	11	81.2 ± 12.70 <sup>abcd</sup>
TRN	41	41.0 ± 2.10 <sup>a</sup>	4	108.5 ± 26.3 <sup>abc</sup>	35	44.3 ± 2.84 <sup>a</sup>	6	107.3 ± 10.10 <sup>abcd</sup>
SFC	62	59.24 ± 3.28	2	104.4 ± 0 <sup>bd</sup>	36	65.5 ± 5.01 <sup>b</sup>	8	116.0 ± 20.4 <sup>abcd</sup>
SFN	37	84.96 ± 8.78	1	1146.7 <sup>cd</sup>	32	83.7 ± 8.58 <sup>b</sup>	11	161.9 ± 36.10 <sup>abcd</sup>
TR Habitat	81	41.3 ± 1.66	18	72.5 ± 9.20	72	43.4 ± 2.00	17	90.4 ± 9.27
SF Habitat	99	68.9 ± 4.05	3	452.0 ± 347.00	68	74.0 ± 4.92	19	142.6 ± 22.7
TOTAL <sup>1</sup>	180	56.4 ± 2.56	21	126.7 ± 51.60	14	58.2 ± 2.90	36	117.9 ± 13.3

### 2002

#### Kruskal-Wallis:

#### NND of Middens

among all areas

H=55.19

df=3

**P<0.0001**

### 2003

H = 38.78

df=3

**P<0.0001**

#### NND of Squirrels

among all areas

H=8.03

df=3

**P=0.045**

H = 4.36

df=3

P = 0.225

a,b,c,d Means within the same category, with the same letter(s), of the same year, are not significantly different. Kruskal-Wallis test was used as 2002 data are not normal. Means are shown for comparison with previous year.

<sup>1</sup> Includes only middens on the monitored areas.

Figure 2a. Corkbark fir seed fall, 1993-2002. Note: scales are different for figures 2a-c.

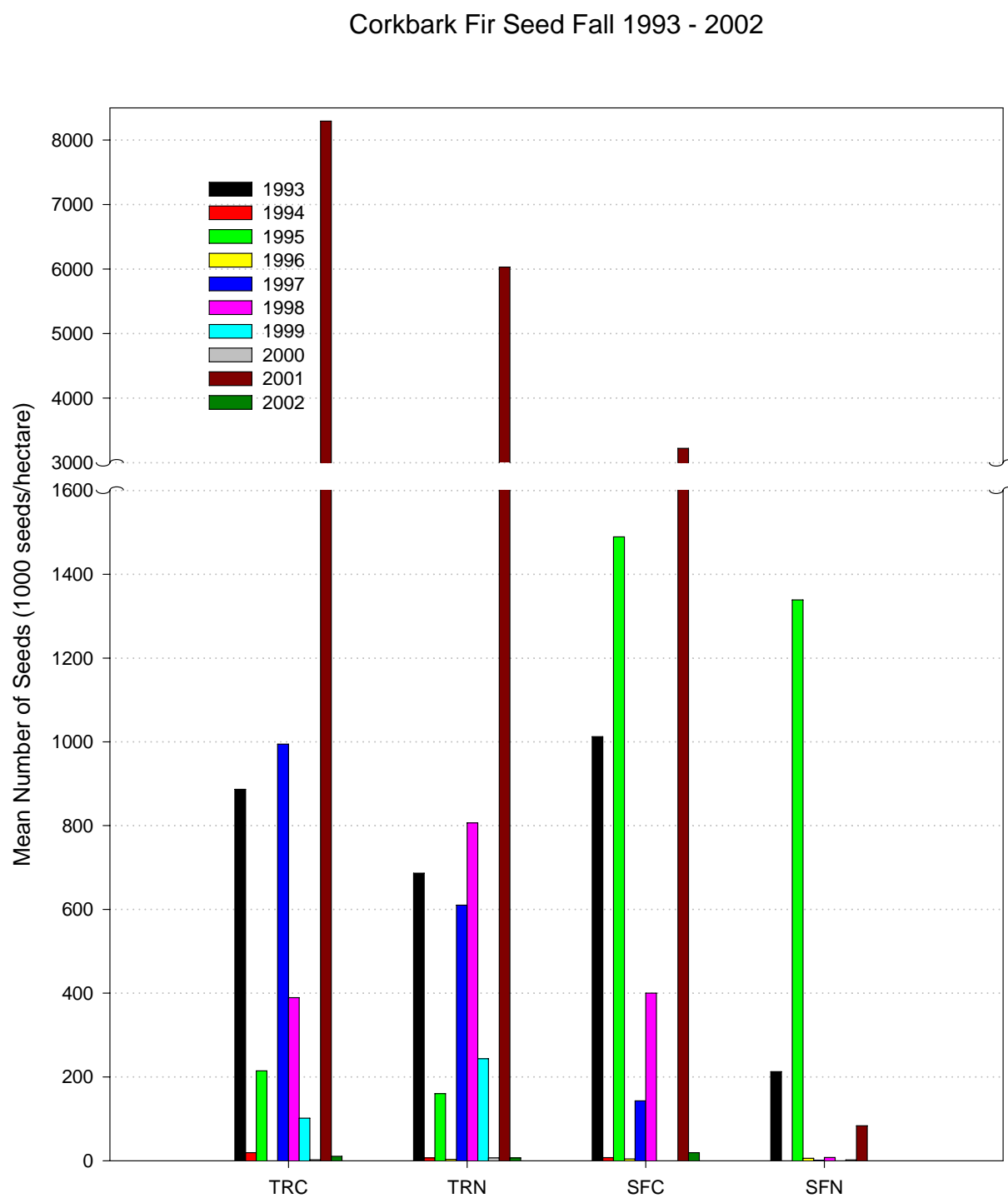


Figure 2b. Douglas-fir seed fall, 1993-2002. Note: scales are different for figures 2a-c.

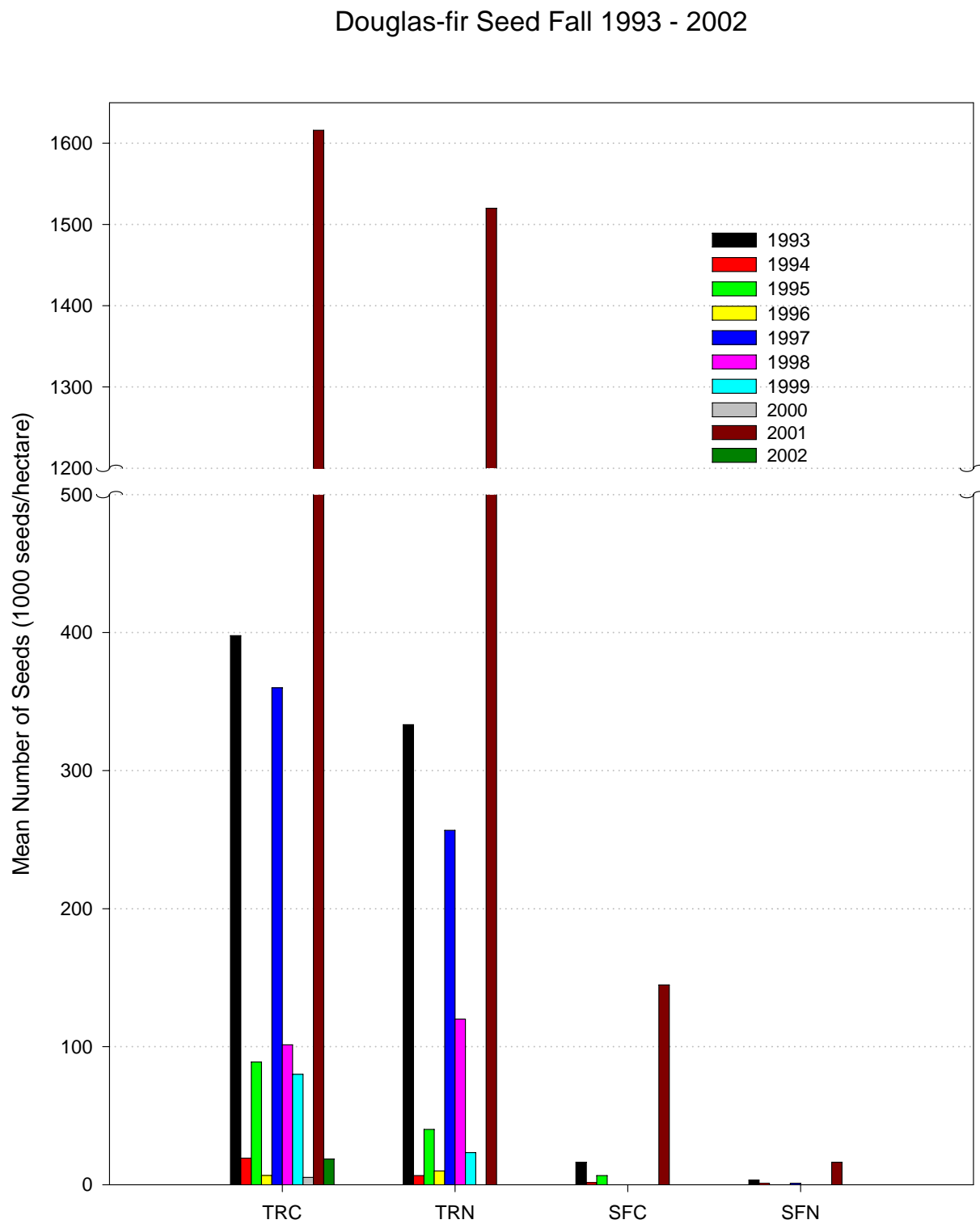


Figure 2c. Engelmann spruce seed fall, 1993-2002. Note: scales are different for figures 2a-c.

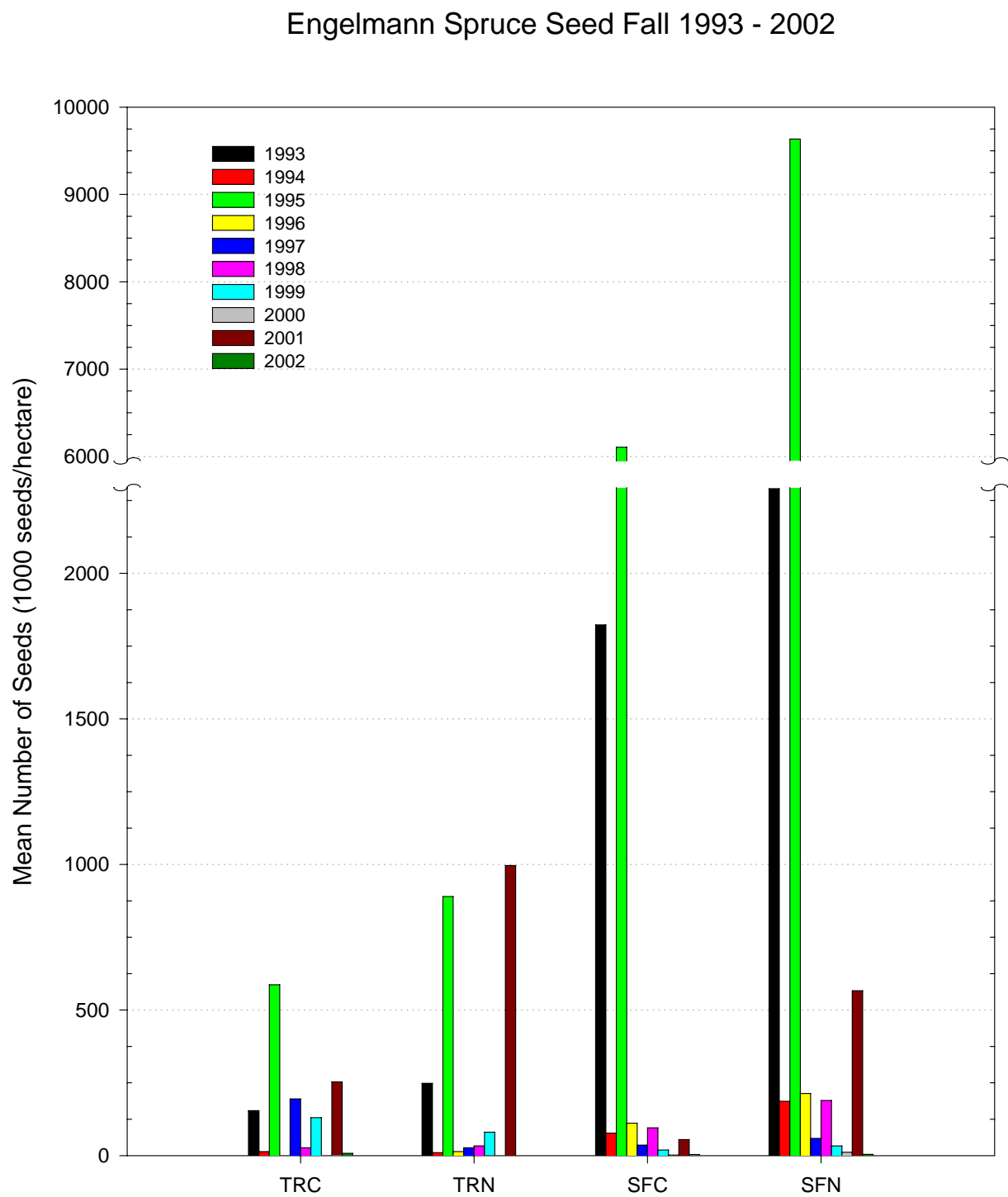




Figure 3. Mushroom crops, 1994-2003.

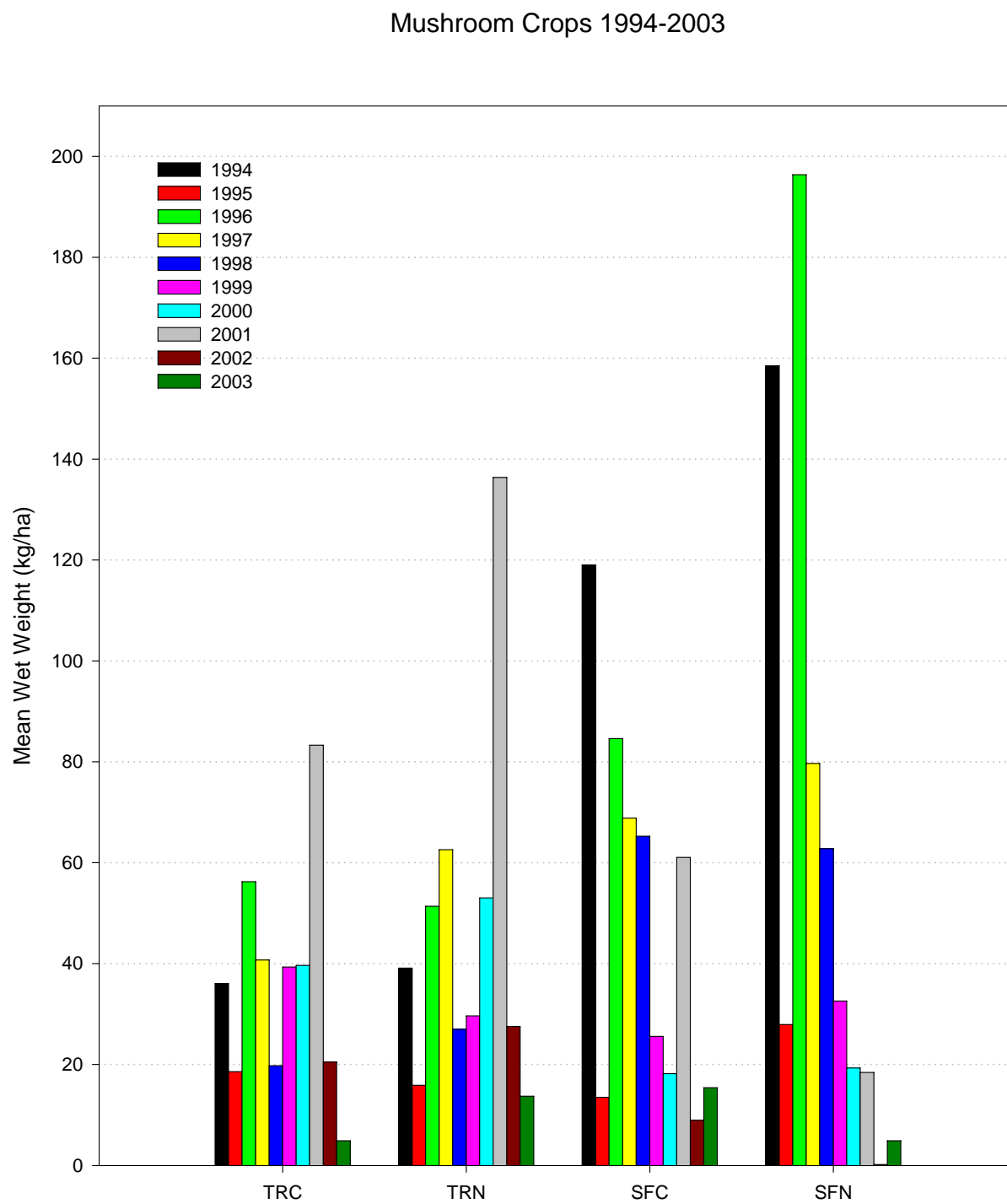


Figure 4. Red squirrel populations (including juveniles) on the monitored areas, December 2002 - December 2003.

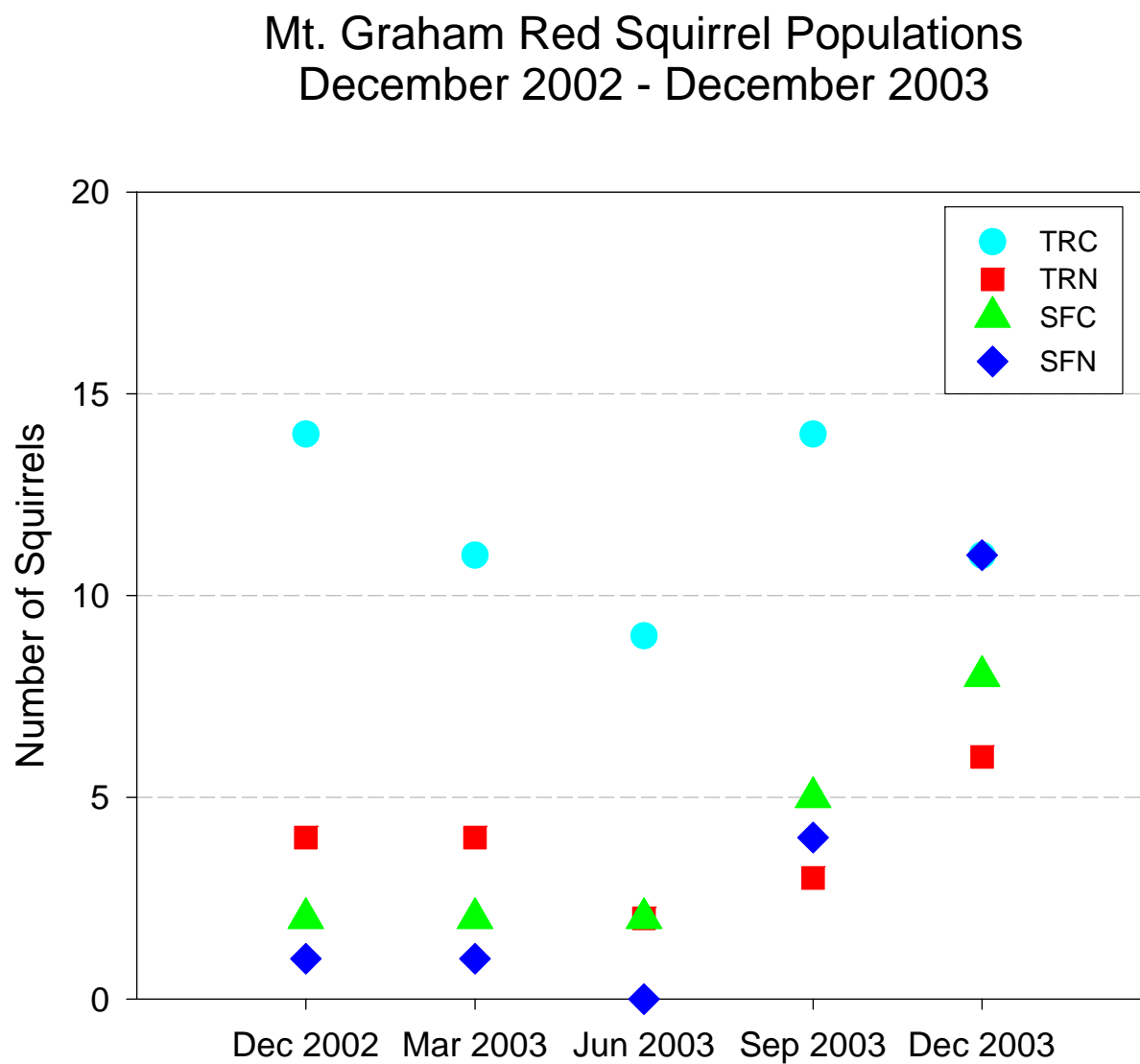


Figure 5. Crude density of middens and squirrels, 2002-2003.

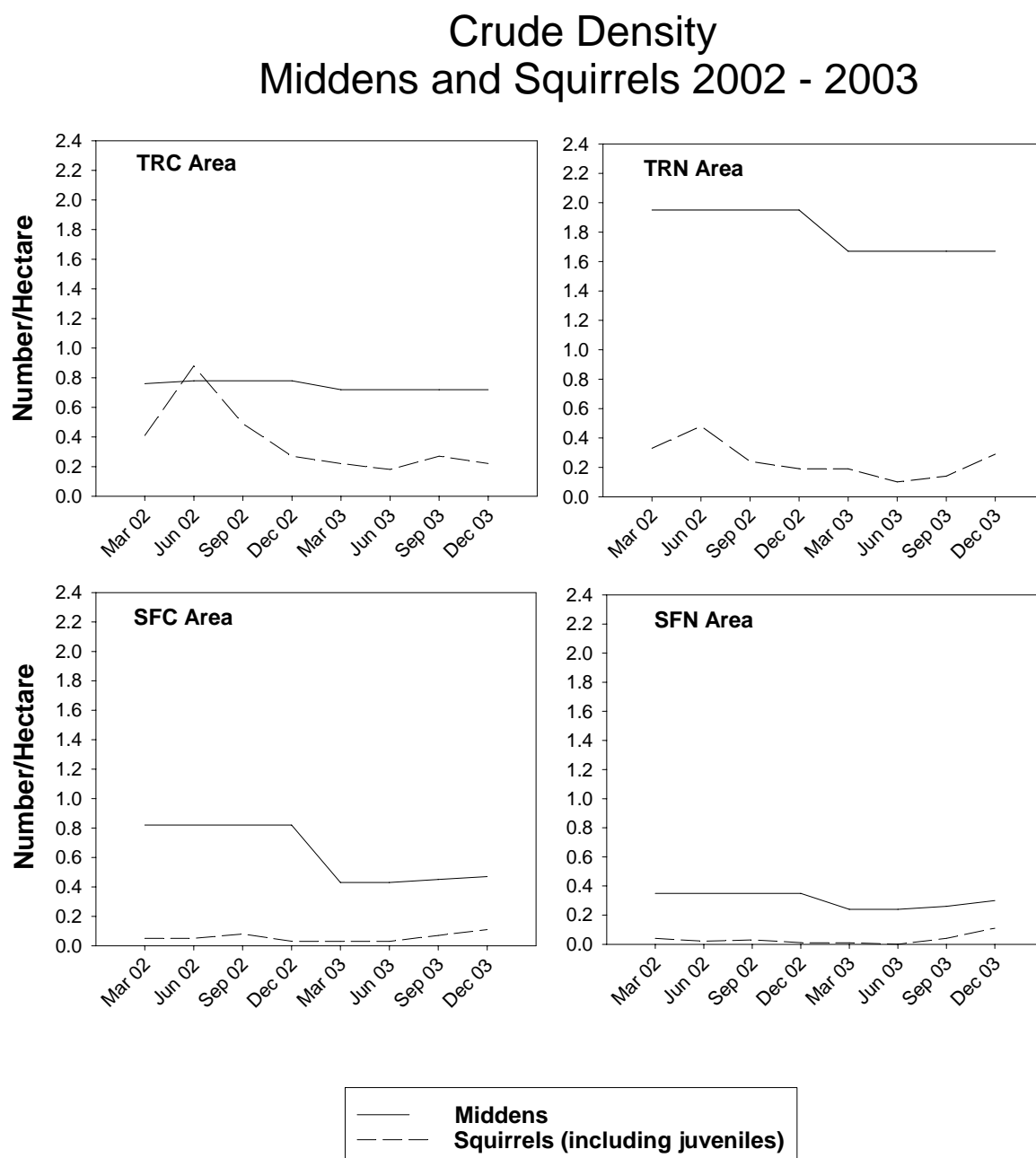


Figure 6. Local density of middens and squirrels, 2002-2003

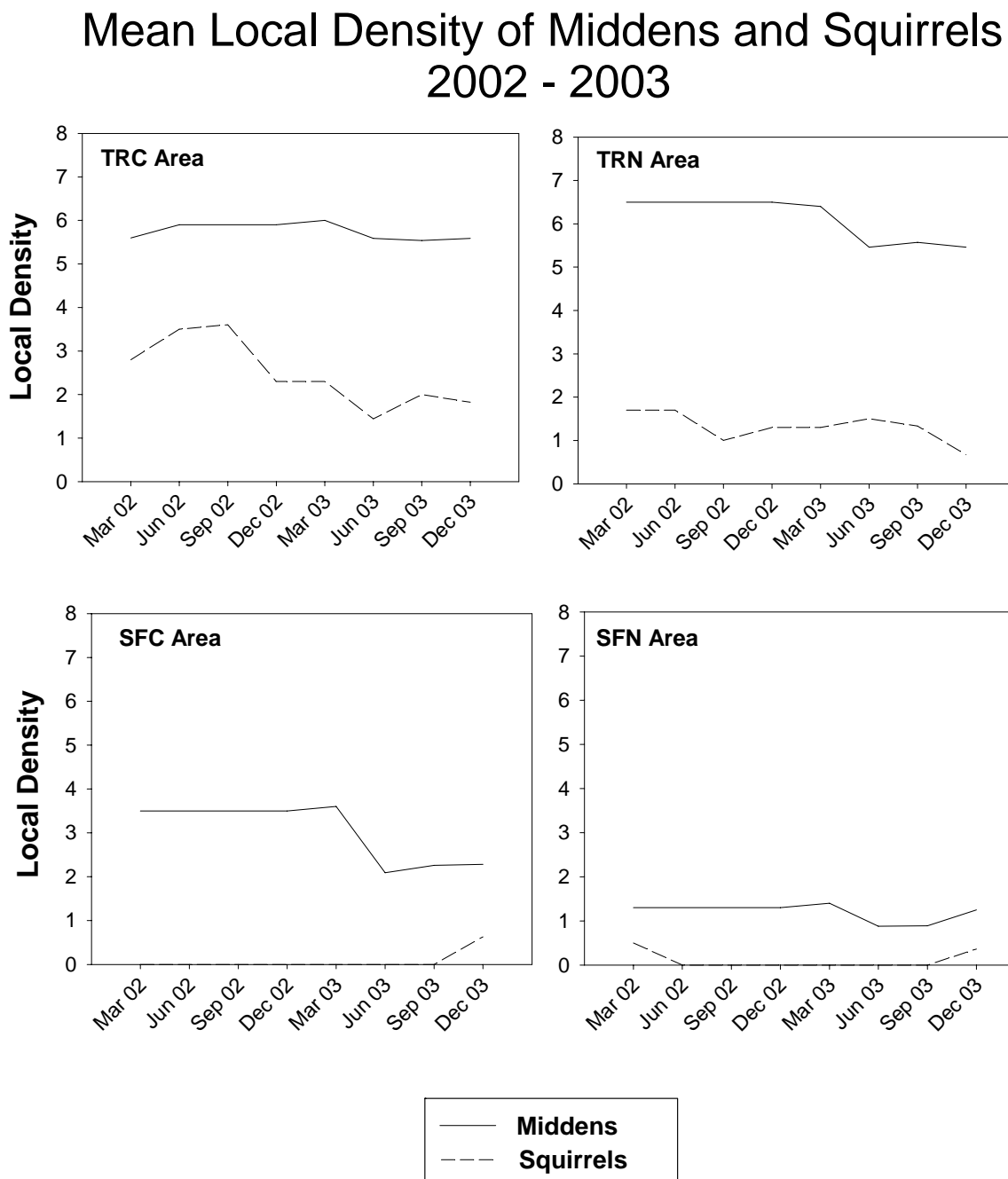


Figure 7. Nearest neighbor distance of middens and squirrels, 2002-2003.

## Mean Nearest Neighbor Distance - Middens and Squirrels 2002 - 2003

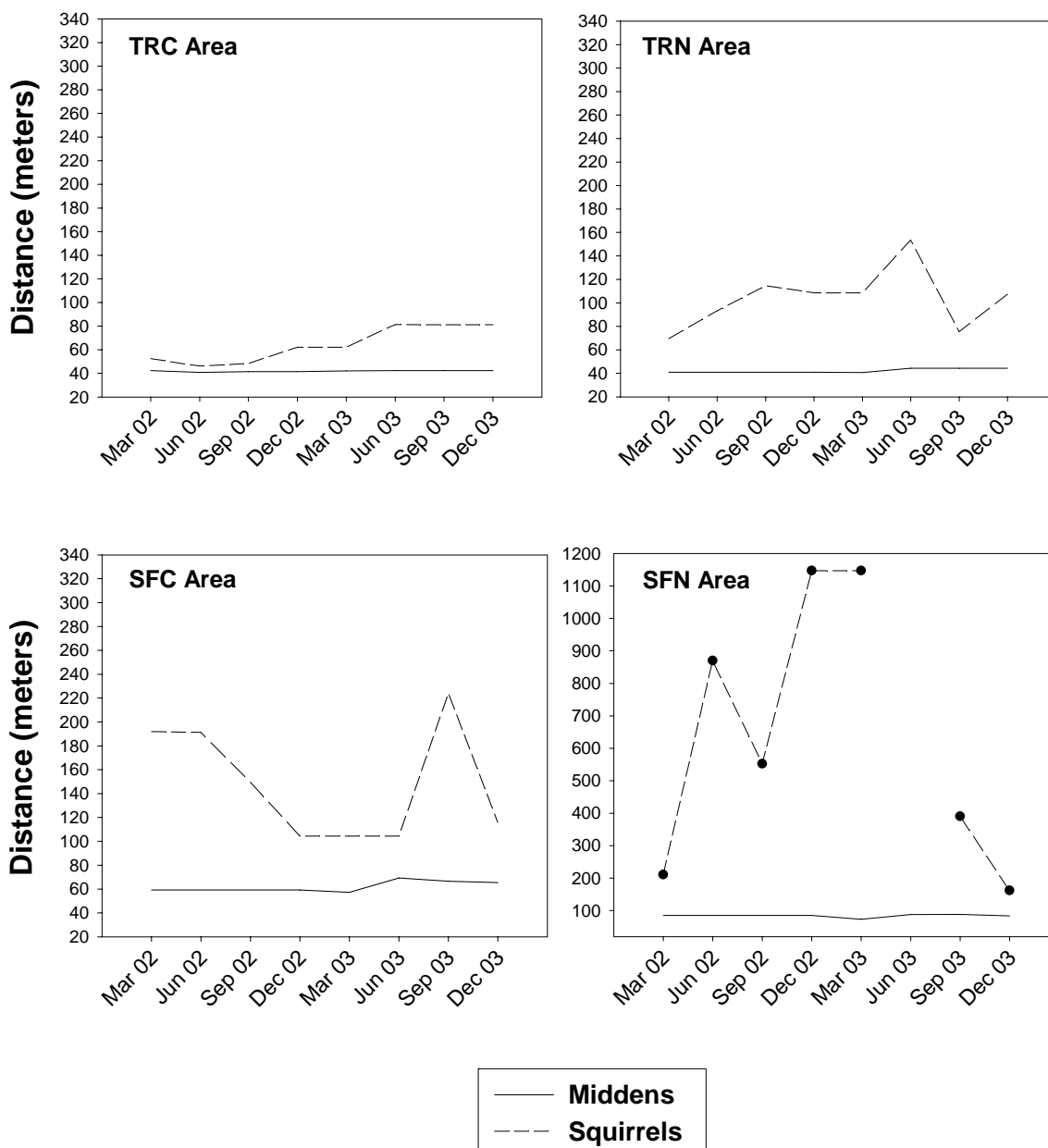


Figure 8. Monthly temperatures on the monitored areas, 2003.

### 2003 Temperatures

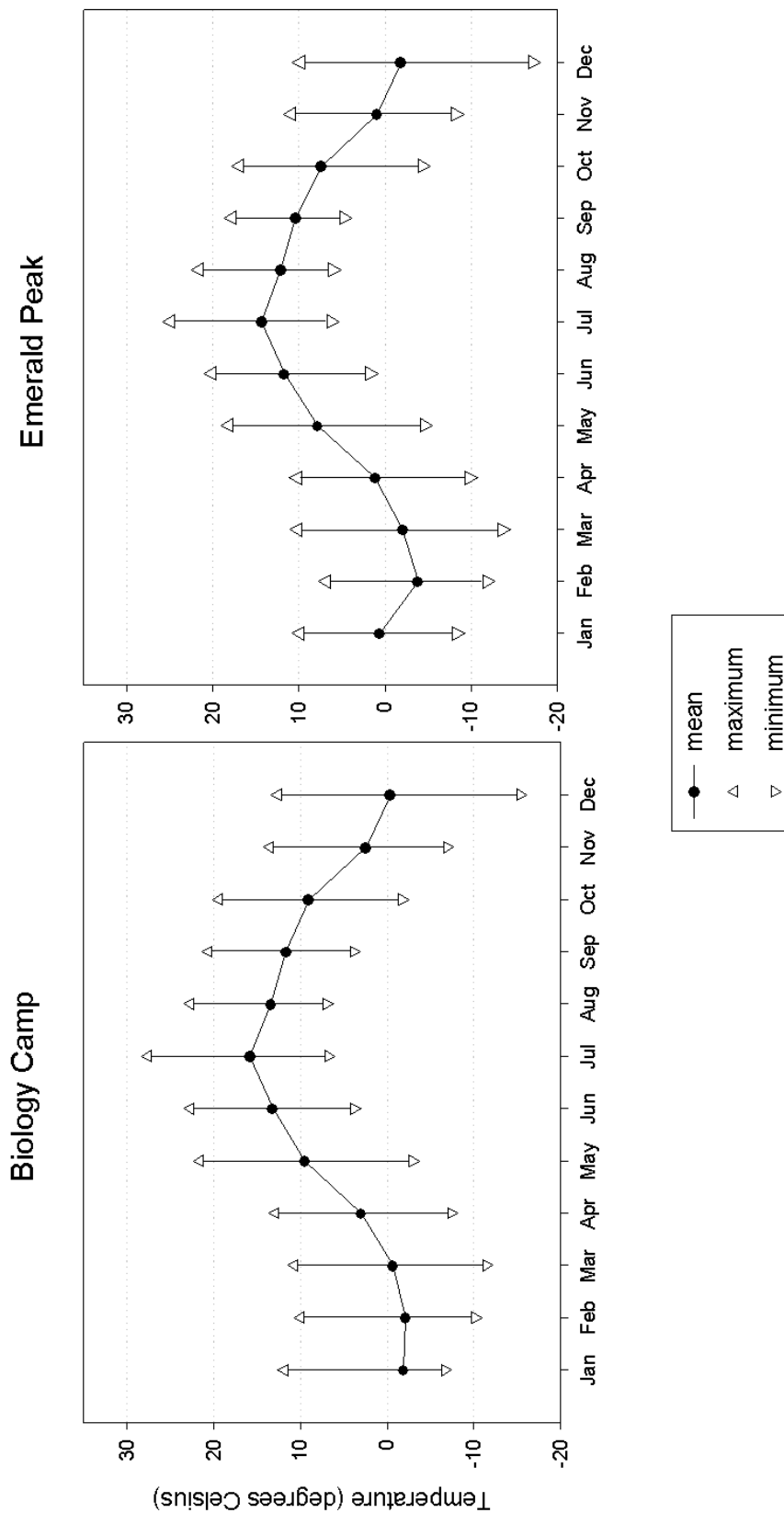


Figure 9. Total monthly precipitation as rain, 2003.

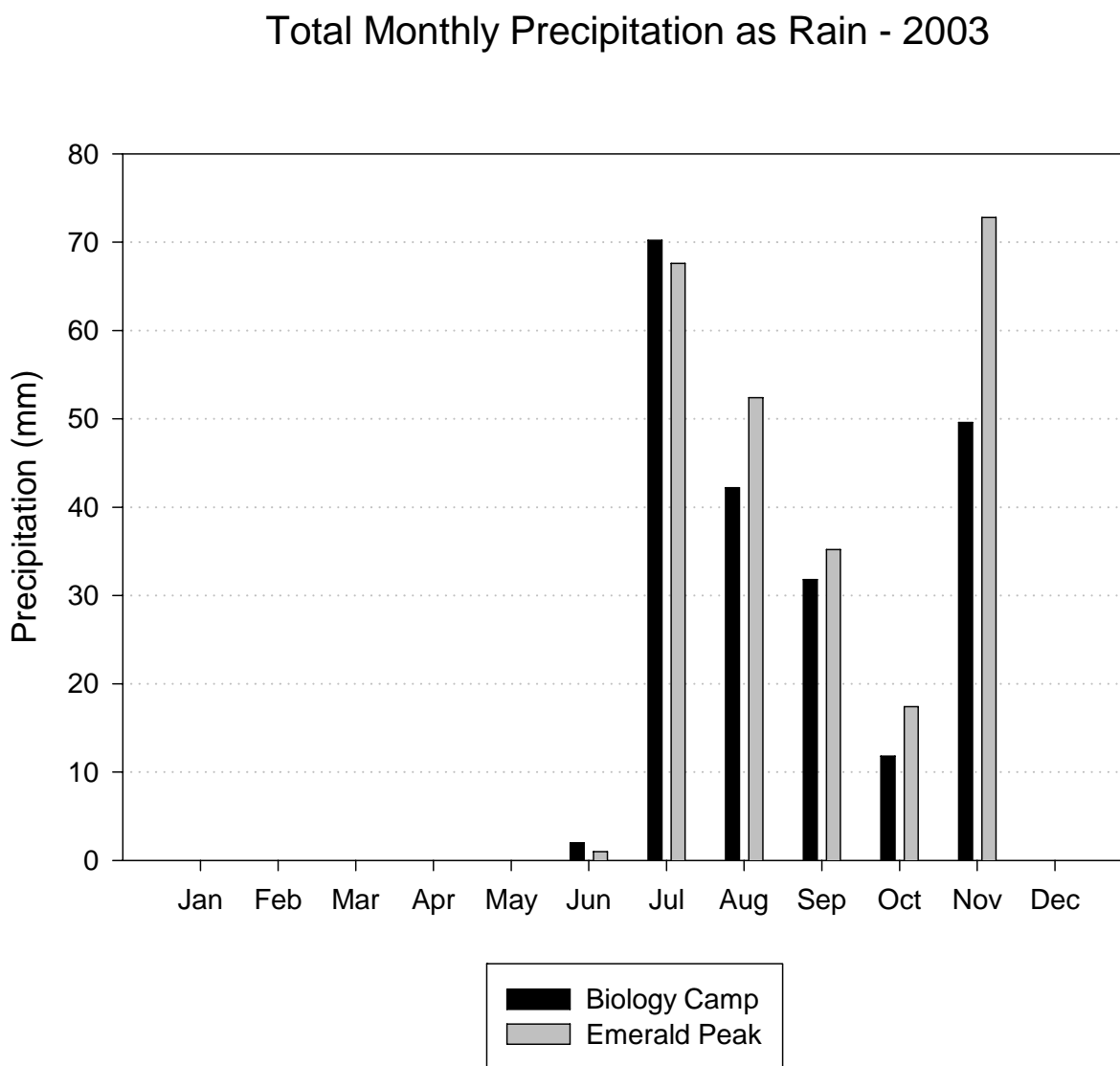
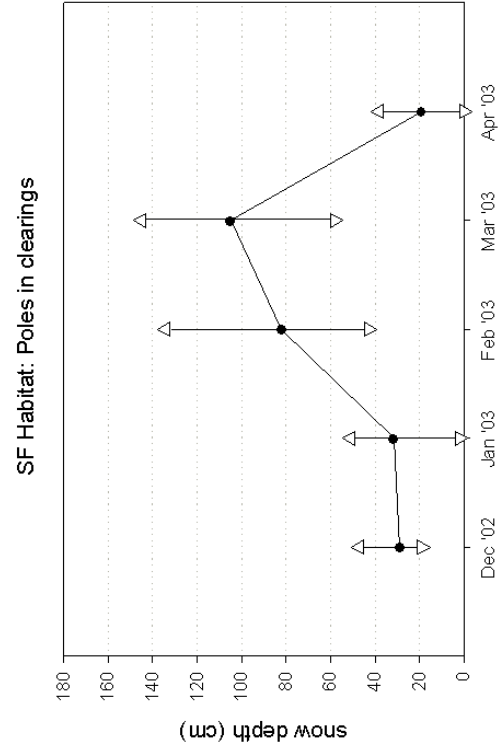
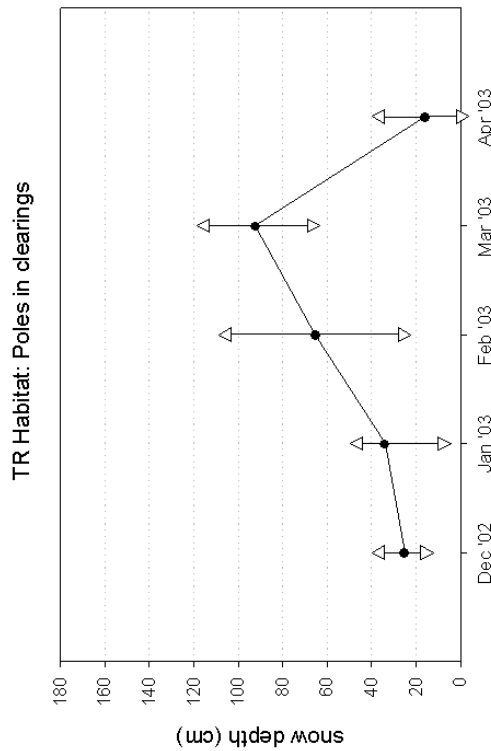
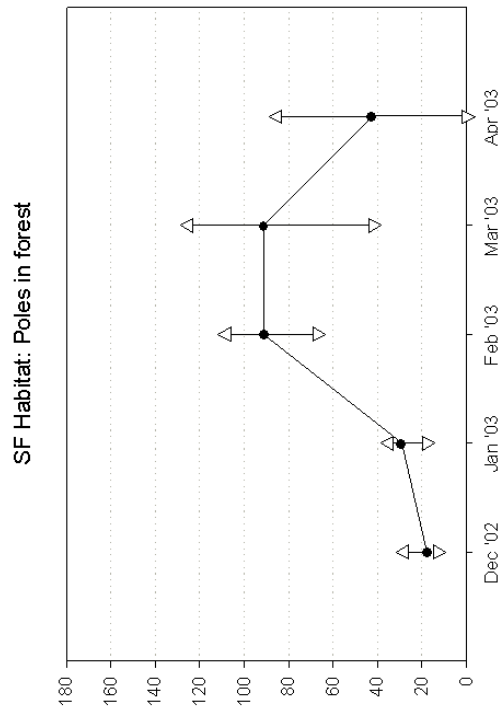
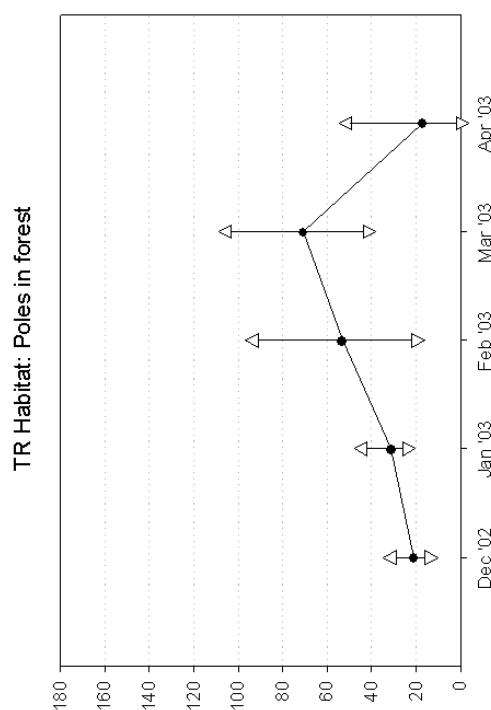
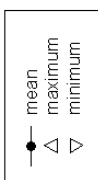


Figure 10. Accumulated snow depths, 2002-2003.

**Accumulated snow depths, 2002-2003**





Appendix A. Mean numbers and weights for 2002 seeds and 2002 mushrooms.

A-1: By transect

A-2: By area and habitat

Appendix A-1: Mean number of seeds and weights for 2002 seeds and 2002 mushrooms, by transect.

AREA	TRAN #	Corkbark Fir	Douglas-fir	Englemann Spruce	Total Seeds	Total Mushrooms	
		# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	ww Kg/ha	dw Kg/ha
TRC	1				burned		
	2				burned		
	3	0.0	0.0	0.0	0.0	28.8	2.7
	4				burned		
	5	53.2	0.0	0.0	0.0	12.0	1.2
	6				burned		
	7				burned		
	8				burned		
	9				burned		
	10	0.0	26.4	0.0	26.4	45.7	4.3
	11	0.0	40.0	40.0	13.2	4.1	0.4
	12	0.0	26.4	0.0	26.4	11.9	1.2
TRN	1	26.4	0.0	0.0	26.4	38.8	4.1
	2	0.0	0.0	0.0	0.0	22.7	2.2
	3	0.0	0.0	0.0	0.0	28.8	2.7
	4	0.0	0.0	0.0	0.0	19.8	1.8

AREA	TRAN #	Corkbark Fir	Douglas-fir	Englemann Spruce	Total Seeds	Total Mushrooms	
		# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	ww Kg/ha	dw Kg/ha
SFC	1	66.4	0.0	0.0	66.4	13.0	1.2
	2			burned			
	3	66.4	0.0	0.0	66.4	8.8	1.1
	4	0.0	0.0	0.0	0.0	7.8	0.9
	5	0.0	0.0	0.0	0.0	4.2	0.5
	6	0.0	0.0	0.0	0.0	4.8	0.5
	7			burned			
	8			burned			
	9			burned			
	10	0.0	0.0	26.4	26.4	4.7	0.4
	11	0.0	0.0	0.0	0.0	19.3	2.5
SFN	1	0.0	0.0	0.0	0.0	1.0	0.2
	2	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	40.0	40.0	<0.1	<0.1
	5	0.0	0.0	13.2	13.2	0.9	0.1
	6	0.0	0.0	0.0	0.0	0.0	0.0
	7	0.0	0.0	0.0	0.0	0.3	<0.1
	8	0.0	0.0	0.0	0.0	0.3	0.1
	9	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	0.0	0.0	0.0	0.0
	11	0.0	0.0	0.0	0.0	0.0	0.0
	12	0.0	0.0	0.0	0.0	0.0	0.0

Appendix A-2: Mean number of seeds and weights for 2002 seeds and 2002 mushrooms, by area and habitat.

AREA	N	Corkbark Fir	Douglas-fir	Englemann Spruce	Total Seeds	Total Mushrooms	
		# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	ww Kg/ha	dw Kg/ha
TRC $\bar{x}$	5	10.6	18.6	8.0	39.8	20.5	1.9
TRN $\bar{x}$	4	6.6	0.0	0.0	6.6	27.5	2.7
SFC $\bar{x}$	7	19.0	0.0	3.8	22.7	9.0	1.0
SFN $\bar{x}$	12	0.0	0.0	4.4	4.4	0.2	<0.1
TR $\bar{x}$	9	8.8	10.3	4.4	25.1	23.6	2.3
SF $\bar{x}$	19	7.0	0.0	4.2	11.2	3.4	0.4

Appendix B. Midden occupancy records for the monitored areas, 2003.

B-1. Quarterly occupancy records

B-2. Activity area information

## Appendix B-1: Midden occupancy records for the monitored areas, 2003.

## KEY

For Midden Numbers:

###<sup>89\*</sup> Midden Number <sup>'Year Found'</sup> '\*' 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
SA	Occupied, Sub-adult Red Squirrel
A	Abert's Squirrel using area, no Red Squirrel present
XX	Remains of Red Squirrel found
* or <sup>(R/R)</sup>	Squirrel is tagged (letters indicate ear tag colors - left ear/right ear) [B - blue, G - green, M - metal, O - orange, P - pink, R - red, Y - yellow, W - white N - none, - - rip] [tag shape is round unless noted: sq - square, tr - triangle]
NAT	Squirrel is naturally marked - ear notch, short tail, etc.
-	Midden not checked, no data
♀L	Adult female Red Squirrel, lactating
♀+'#'	Adult female Red Squirrel with '#' juveniles
RC	Radio-collared Red Squirrel



Shaded cell indicates a midden that has been renumbered or removed from censusing.

Transition Construction Area (TRC), 2003				
Midden	Mar	Jun	Sep	Dec
1101 <sup>89</sup>	located off-area, new number - 5101			
1102 <sup>89</sup>	N <sup>2</sup>	♀ <sup>(W/O RC)</sup> 2	N <sup>2</sup>	♂ <sup>(G/R)</sup> 14
1103 <sup>89</sup>	♀ <sup>(O/B RC)</sup>	♀ <sup>(O/B RC)</sup>	♀ L <sup>(O/- RC)</sup> + 3 <sup>10</sup>	N <sup>10</sup>
1104 <sup>89</sup>	♀ <sup>(Y/P RC)</sup>	N <sup>5</sup>	N	♀ <sup>(O/- RC)</sup> 10
1105 <sup>89</sup>	burned in Clark Peak fire			
1106 <sup>89</sup>	N	N	N	N
1107 <sup>89</sup>	burned in Clark Peak fire			
1108 <sup>89</sup>	removed from census - low occupancy <sup>1</sup>			
1109 <sup>89</sup>	burned in Clark Peak fire			
1110 <sup>89*</sup>	burned in Clark Peak fire			
1111 <sup>89</sup>	N	N	N	N
1112 <sup>89*</sup>	N	N	N	N
1113 <sup>89</sup>	N-XX <sup>3</sup>	N	N	N
1114 <sup>89</sup>	located off-area, new number - 5114			
1115 <sup>89</sup>	N <sup>4</sup>	N	♀ L <sup>(B/W RC)</sup> + 3 <sup>11</sup>	N <sup>11</sup>
1116 <sup>89</sup>	♀ <sup>(W/O RC)</sup> 2	N <sup>2</sup>	♂ <sup>(P/G RC)</sup>	♂ <sup>(P/G RC)</sup>
1117 <sup>89</sup>	burned in Clark Peak fire			
1118 <sup>89</sup>	♂ <sup>(Y/Y RC)</sup>	♂ <sup>(Y/Y RC)</sup> 6	P	♂
1119 <sup>88</sup>	burned in Clark Peak fire			
1120 <sup>89</sup>	burned in Clark Peak fire			
1121 <sup>89*</sup>	N	N	N	P
1122 <sup>89</sup>	burned in Clark Peak fire			
1123 <sup>95*</sup>	burned in Clark Peak fire			
1124 <sup>95*</sup>	burned in Clark Peak fire			
1125 <sup>95*</sup>	burned in Clark Peak fire			
1126 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
1130 <sup>90</sup>	burned in Clark Peak fire			
1131 <sup>90*</sup>	N	N	♀ L <sup>(R/R RC)</sup> + 1 <sup>8</sup>	♀ <sup>(M/M)</sup> 8
1132 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
1134 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
1135 <sup>91*</sup>	burned in Clark Peak fire			
1136 <sup>91*</sup>	burned in Clark Peak fire			

Transition Construction Area (TRC), 2003				
Midden	Mar	Jun	Sep	Dec
1137 <sup>91*</sup>	burned in Clark Peak fire			
1138 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
1139 <sup>91*</sup>	burned in Clark Peak fire			
1140 <sup>91*</sup>	burned in Clark Peak fire			
1142 <sup>91*</sup>	burned in Clark Peak fire			
1143 <sup>91*</sup>	burned in Clark Peak fire			
1144 <sup>91*</sup>	♀ (P/W)	♀ (P/W RC)	♀ (P/W RC)	♀ (P/W RC)
1145 <sup>91*</sup>	located off-area, new number - 5145			
1146 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
1147 <sup>91*</sup>	N	N	N	♂
1148 <sup>91*</sup>	burned in Clark Peak fire			
1149 <sup>91*</sup>	N	N	N	N
1150 <sup>91*</sup>	located off-area, new number - 5150			
1151 <sup>91*</sup>	N	N	N	N
1152 <sup>91*</sup>	burned in Clark Peak fire			
1153 <sup>92*</sup>	♂ (W/R RC)	♂ (W/R RC)	♂ (O/G RC) <sup>9</sup>	♂ (O/G RC)
1154 <sup>92*</sup>	N	N	N	N
1155 <sup>93*</sup>	located off-area, new number - 5155			
1156 <sup>93*</sup>	♀ (P/P RC)	N <sup>7</sup>	N	♀ (R/R)
1157 <sup>93*</sup>	located off-area, new number - 5157			
1159 <sup>93*</sup>	burned in Clark Peak fire			
1160 <sup>96*</sup>	♀ (R/R RC)	♀ (R/R RC) <sup>8</sup>	P <sup>8</sup>	N
1161 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
1162 <sup>96*</sup>	♂ (R/O RC)	♂ (R/O RC)	N <sup>12</sup>	♂
1163 <sup>98*</sup>	N	N	P <sup>8</sup>	N
1164 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
1165 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
1166 <sup>98*</sup>	N	N	N	N
1167 <sup>98*</sup>	N	N	P	N
1168 <sup>98*</sup>	N	N	N	N
1169 <sup>98*</sup>	N	N	N	N
1170 <sup>98*</sup>	♀ (B/-- RC) <sup>4</sup>	♀ (B/-- RC)	♂ (W/R RC) <sup>13</sup>	♂ (W/R RC)



Transition Construction Area (TRC), 2003				
Midden	Mar	Jun	Sep	Dec
1171 <sup>98*</sup>	N	N	N	N
1172 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
1173 <sup>99*</sup>	N	N	N	N
1174 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			
1175 <sup>99*</sup>	N	N	N	N
1176 <sup>99*</sup>	N	N	N	N
1177 <sup>99*</sup>	♂ (O/G RC)	♂ (O/G RC) <sup>9</sup>	N <sup>9</sup>	N
1178 <sup>99*</sup>	N	N	N	N
1179 <sup>99*</sup>	N	N	N	N
1180	N	N	N	N
1181	N	N	N	N
1182 <sup>02*</sup>	N	N	N	N
# Mid	37	37	37	37
# Occ	11	9	7	11
% Occ	30	24	19	30
# Sq	11	9	7 + 7J	11

Table 2 - TRC (cont.)

- 1 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 2 The female (W/O RC), former resident of midden 1102, was found in a nest at midden 1116 on 10 Feb 03 and has been found there consistently during the first quarter. She was determined to be the resident of midden 1116 during the March census. By June, this female had shifted her residence back to midden 1102. The last telemetry point and visual record for female (W/O RC) were recorded on 1 Jul 03. Her collar was retrieved from a nest cavity in a log on 12 Dec 03. Her fate remains undetermined.
- 3 The remains of female (O/O RC), former resident of midden 1113, were found north of midden 1131 on 23 Jan 03.
- 4 Female (B/--(W) RC), moved from midden 1115 to 1170 between the December 02 and March 03 censuses.
- 5 Female (Y/P RC) moved from midden 1104 to midden 5221 (approx. 200 m NE of 1104), between the January and March censuses.
- 6 Male (Y/Y RC) was resident at midden 1118 during the June census. Telemetry data show him in the area of the midden. On 9 Jun 03, his radio collar was found near the midden. However, no sign of predation was found, so his fate was undetermined. Therefore he was considered resident at midden 1118 for the month of June as he was present at the beginning of the month.
- 7 The remains and radiocollar of female (P/P RC), resident of midden 1156 in March 2003, were found on 28 Apr 03. Evidence indicated this was likely a raptor kill.
- 8 Radio telemetry data for June indicated that female (R/R RC) was spending time across the road at a possible maternity nest. However, there was still fresh sign at midden 1160 and she was considered resident there for the June census. On 24 Aug 03 she was then observed in a nest tree near midden 1163 with five juveniles. However, only 1 juvenile (male caught and marked with metal ear tags) was observed during the September census. The female (R/R RC) was located in midden 1131 (feeding sign and caching) during the September census, but her radio collar was later found on 17 September. There were no signs of predation and her fate was undetermined. Therefore, she was counted as resident of midden 1131 for the entire month of September. The subadult female (M/M) resident of midden 1131 in December, was later caught on 8 Jan 04 and confirmed to be the offspring of female (R/R RC). The subadult female received new tags (Rsq/Gsq).
- 9 Radio telemetry data for June indicated that this male (O/G RC) was spending some time on the north end of the TRN area, and was observed in a breeding chase near off-area midden BC-44. However, there was still fresh sign at midden 1177 and he was considered resident there for the June census. By September, however, this male (O/G RC) had moved to midden 1153.

- 10 Four juveniles, offspring of female (O/-- RC), were observed on 22 Aug 03 at a maternity nest near midden 1103, but only three were observed during the September census. One of the male juveniles was marked with metal ear tags. Female (O/-- RC) moved from midden 1103 to midden 1104 between the September and December censuses.
- 11 Four juveniles, offspring of female (B/W RC), were observed at midden 1115 on 24 Aug 03, but only three were seen during the census (the group of three juveniles were seen on three different occasions). Female (B/W RC) moved from midden 1115 to midden 5121 between the September and December censuses.
- 12 Male (R/O RC) moved from midden 1162 to midden 5101 between the June and September censuses.
- 13 Female (B/--(W) RC) moved from midden 1170 to midden 1115 between the June and September censuses. The new resident of midden 1170 in September, male (W/R RC), was formerly resident at midden 1153.
- 14 Subadult male (G/R), resident (Dec 03) of midden 1102, is the offspring of female (O/-- RC), resident of midden 1104 (Dec 03).

Transition Non-Construction Area (TRN), 2003				
Midden	Mar	Jun	Sep	Dec
2201 <sup>89</sup>	removed from census - low occupancy <sup>1</sup>			
2202 <sup>89</sup>	N	N	N	N
2203 <sup>89</sup>	N	N	N	N
2204 <sup>89</sup>	N	N	N	N
2205 <sup>89</sup>	N	N	N	N
2206 <sup>89</sup>	N	N	N	N
2207 <sup>89*</sup>	N	N	N	N
2208 <sup>89*</sup>	♀ (W/G RC)	♀ (W/G RC)	N <sup>4</sup>	N
2209 <sup>89</sup>	removed from census - low occupancy <sup>1</sup>			
2210 <sup>90</sup>	N	N	N	P
2211 <sup>90*</sup>	N	N	P	♀ (G/B RC)
2212 <sup>90</sup>	N	N	N	N
2213 <sup>90</sup>	removed from census - low occupancy <sup>1</sup>			
2214 <sup>90*</sup>	located on TRC, new number - 1172			
2215 <sup>90*</sup>	N	N	♂ (R/Y RC)	♂ (R/Y RC)
2216 <sup>90*</sup>	N	N	♀ (W/G RC) <sup>4</sup>	♂ (G/G) <sup>4</sup>
2217 <sup>90*</sup>	N	N	♀ L (G/B RC)	N
2218 <sup>91*</sup>	N	N	N	♂
2219 <sup>91*</sup>	N	N	N	N
2220 <sup>91*</sup>	N	N	N	N
2221 <sup>91*</sup>	located off-area, new number - 5221			
2222 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
2223 <sup>91*</sup>	N	N	N	N
2224 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
2225 <sup>94</sup>	removed from census - low occupancy <sup>1</sup>			
2226 <sup>95*</sup>	N	N	N	N
2227 <sup>95*</sup>	N	N	N	N
2228 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
2229 <sup>96*</sup>	N	N	N	♂
2230 <sup>96*</sup>	N	N	N	N
2231 <sup>96*</sup>	located off-area, new number - 5231			

Transition Non-Construction Area (TRN), 2003				
Midden	Mar	Jun	Sep	Dec
2232 <sup>96*</sup>	located off-area, new number - 5232			
2233 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
2234 <sup>97*</sup>	♀ (Y/G RC)	N <sup>2</sup>	P	N
2235 <sup>98*</sup>	N	N	N	N
2236 <sup>98*</sup>	N	N	N	N
2237 <sup>98*</sup>	♂ (Y/B RC)	N <sup>3</sup>	N	N
2238 <sup>98</sup>	removed from census - low occupancy <sup>1</sup>			
2239 <sup>98</sup>	removed from census - low occupancy <sup>1</sup>			
2240 <sup>98</sup>	removed from census - low occupancy <sup>1</sup>			
2241 <sup>98*</sup>	N	N	N	N
2242 <sup>98*</sup>	♀ (P/G RC)	♀ (P/G RC)	P <sup>5</sup>	♂ (O/W)
2243 <sup>98</sup>	removed from census - low occupancy <sup>1</sup>			
2244 <sup>99*</sup>	N	N	N	N
2245 <sup>99*</sup>	N	N	N	N
2246 <sup>99*</sup>	N	N	N	N
2247 <sup>99*</sup>	N	N	N	N
2248 <sup>99*</sup>	N	N	N	N
2249 <sup>99*</sup>	N	N	N	N
2250 <sup>00*</sup>	N	N	N	N
2251 <sup>00*</sup>	N	N	N	N
# Mid	35	35	35	35
# Occ	4	2	3	6
% Occ	11	6	9	17
# Sq	4	2	3	6

Table 2 - TRN (cont.)

- 1 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 2 The collar of female (Y/G RC), former resident of 2234, was found about 17 meters north of midden 2225 on 8 Apr 03. There was a minute amount of fur on the snow, but no definitive sign of predation. This animal's fate is undetermined, but is likely dead.
- 3 The collar of male (Y/B RC), former resident of midden 2237, was found about 15 meters east of Arizona Game and Fish midden BC-11 on 14 Apr 03. There was some fur and the tip of a red squirrel tail found in the same area, but no definite sign of a predator. This animal's fate is undetermined, but is likely dead.
- 4 Female (W/G RC) moved from midden 2208 to midden 2216 between the June and September censuses. This female was found dead on 27 Oct 03 in an open area near midden 2215. Her body, collar, and ear tags were intact and the cause of death was unknown. By December, subadult male (G/G) was the new resident of midden 2216
- 5 The collar and desiccated carcass of female (P/G RC) was found near midden 2242 on 7 Aug 03. In September, there was a small amount of feeding sign found, but it was uncertain if there was a new permanent resident.

Spruce-Fir Construction Area (SFC), 2003				
Midden	Mar	Jun	Sep	Dec
3000 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3001 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3002 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3003 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3004 <sup>95*</sup>	burned in Clark Peak fire			
3005 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3006 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3007 <sup>95*</sup>	removed from census - too far off area, new # 5307			
3008 <sup>95*</sup>	N	N	N	N
3009 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3010 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3011 <sup>95*</sup>	located off-area, new number - 5311			
3012 <sup>95*</sup>	burned in Clark Peak fire			
3013 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3014 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3015 <sup>95*</sup>	burned in Clark Peak fire			
3016 <sup>95*</sup>	burned in Clark Peak fire			
3017 <sup>95*</sup>	burned in Clark Peak fire			
3018 <sup>95*</sup>	burned in Clark Peak fire			
3019 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
3020 <sup>96*</sup>	N	N	N	N
3021 <sup>96*</sup>	burned in Clark Peak fire			
3022 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
3023 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
3024 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
3025 <sup>98*</sup>	N	N	N	N
3026 <sup>98*</sup>	N	N	N	N
3027 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			
3028 <sup>99*</sup>	N	N	N	N
3029 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			
3030 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			
3031 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			
3032 <sup>99*</sup>	removed from census - low occupancy <sup>1</sup>			

Spruce-Fir Construction Area (SFC), 2003				
Midden	Mar	Jun	Sep	Dec
3300 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3301 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			♀
3302 <sup>94*</sup>	located off-area, new number - 5302			
3303 <sup>94*</sup>	♀ (B/R RC)	♀L (B/R RC)	N <sup>3</sup>	N
3304 <sup>94*</sup>	N	N	N	N
3305 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
3306 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
3307 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
3308 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3309 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3310 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3311 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>		♀L (B/R RC) + 4 <sup>3</sup>	N <sup>3</sup>
3312 <sup>95*</sup>	N	N	N	N
3313 <sup>95*</sup>	located off-area, new number - 5313			
3314 <sup>95*</sup>	N	N	N	N
3315 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3316 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3317 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3318 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3319 <sup>95*</sup>	N	N	N	N
3320 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3321 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3322 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3323 <sup>95*</sup>	N	N	N	♂
3324 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3325 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3326 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3327 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3328 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3329 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3330 <sup>95*</sup>	N	N	N	N
3331 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3332 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			



Spruce-Fir Construction Area (SFC), 2003				
Midden	Mar	Jun	Sep	Dec
3333 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3334 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3335 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3336 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3337 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3338 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3339 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3340 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3341 <sup>95*</sup>	N	N	N	N
3342 <sup>95*</sup>	N	N	N	N
3343 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3344 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3345 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3346 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3347 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3348 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			♂ (M/M)
3349 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
3350 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
3351 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
3352 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3353 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
3354 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3355 <sup>95*</sup>	N	N	N	N
3356 <sup>86</sup>	N	N	N	N
3357 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3358 <sup>87</sup>	burned in Clark Peak fire			
3359 <sup>87</sup>	burned in Clark Peak fire			
3360 <sup>86</sup>	♂ (G/P RC) 2	♂ (G/P RC)	P 2	♀ (G/P)
3361 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3362 <sup>86</sup>	N	N	N	N
3363 <sup>86</sup>	N	N	N	N
3364 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3365 <sup>86</sup>	N	N	N	♀ (P/R RC)

Spruce-Fir Construction Area (SFC), 2003				
Midden	Mar	Jun	Sep	Dec
3366 <sup>86</sup>	N	N	N	♀
3367 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
3368 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3369 <sup>86</sup>	N	N	N	N
3370 <sup>86</sup>	N	N	N	N
3371 <sup>87</sup>	N	N	N	N
3372 <sup>89</sup>	N	N	N	N
3373 <sup>87</sup>	N	N	N	N
3374 <sup>89</sup>	N	N	N	N
3375 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3376 <sup>86</sup>	located off-area, new number - 5376			
3377 <sup>87</sup>	located off-area, new number - 5377			
3378 <sup>90*</sup>	N	N	N	♀ <sup>(OR RC)</sup>
3379 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
3380 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
3381 <sup>90</sup>	N	N	N	N
3382 <sup>91*</sup>	N	N	N	N
3383 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
3384 <sup>91*</sup>	burned in Clark Peak fire			
3385 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
3386 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
3387 <sup>91*</sup>	N	N	N	N
3388 <sup>92*</sup>	located off-area, new number - 5388			
3389 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3390 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3390 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3391 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3392 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3393 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
3394 <sup>93*</sup>	N	N	N	N
3395 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
3396 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
3397 <sup>86</sup>	N	N	P	♂

Spruce-Fir Construction Area (SFC), 2003				
Midden	Mar	Jun	Sep	Dec
3398 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
3399 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
# Mid	33	33	34	36
# Occ	2	2	1	8
% Occ	6	6	3	22
# Sq	2	2	1 + 4J	8

Table 2 - SFC (cont.)

- 1 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 2 Male (B/G RC), former resident of 3360, was thought to be dead in the nest snag as of the end of January 2003. This has not been confirmed but the animal has not been detected outside of the nest since then, and the radio signal has not moved from the nest tree. The male (G/P RC) was determined to be the new resident of midden 3360 during the January census. On 28 Jul 03, male (G/P RC) was found dead at the base of a tree near midden 3303. The cause of death was unknown.
- 3 Female (B/R RC) moved from midden 3303 from midden 3311 between the June and September censuses. On 5 Sep 03, four juveniles, offspring of female (B/R RC), were seen at a maternity nest west of midden 3311. Two juvenile males were caught shortly after the September census and tagged with metal ear tags. By December the female (B/R RC) had moved to midden 5350.

Spruce-Fir Non Construction Area (SFN), 2003				
Midden	Mar	Jun	Sep	Dec
4000 <sup>95*</sup>	N	N	N	N
4001 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4002 <sup>95*</sup>	N	N	N	N
4003 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4004 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4005 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4006 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4007 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4008 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4009 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4010 <sup>95*</sup>	N	N	P	N
4011 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4012 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4013 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4014 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4015 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>		S	N
4016 <sup>96*</sup>	N	N	N	N
4017 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4018 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4019 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4020 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4021 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
4022 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
4023 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
4024 <sup>98*</sup>	removed from census - low occupancy <sup>1</sup>			
4025 <sup>99*</sup>	N	N	N	N
4400 <sup>89</sup>	removed from census - low occupancy <sup>1</sup>			♀
4401 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
4402 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
4403 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
4404 <sup>95*</sup>	N	N	N	P
4405 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4406 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			

Spruce-Fir Non Construction Area (SFN), 2003				
Midden	Mar	Jun	Sep	Dec
4407 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4408 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4409 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4410 <sup>95*</sup>	located off-area, new number - 5410			
4411 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4412 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4413 <sup>95*</sup>	located off-area, new number - 5413			
4414 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4415 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4416 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4417 <sup>95*</sup>	N	N	N	N
4418 <sup>95*</sup>	N	N	N	N
4419 <sup>95*</sup>	N	N	N	S
4420 <sup>90</sup>	N	N	N	N
4421 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4422 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			S
4423 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4424 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4425 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
4426 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4427 <sup>86</sup>	P	N	N	S
4428 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4429 <sup>86</sup>	N	N	N	N
4430 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4431 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4432 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4433 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
4434 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4435 <sup>86</sup>	Y	N	♂ <sup>NAT 2</sup>	S
4436 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4437 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4438 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
4439 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
4440 <sup>91</sup>	removed from census - low occupancy <sup>1</sup>			

Spruce-Fir Non Construction Area (SFN), 2003				
Midden	Mar	Jun	Sep	Dec
4441 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4442 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4443 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4444 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4445 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4446 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4447 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4448 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4449 <sup>86</sup>	N	N	♂ NAT <sup>3</sup>	S
4450 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4451 <sup>88</sup>	removed from census - low occupancy <sup>1</sup>			
4452 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4453 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4454 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4455 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4456 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4457 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4458 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4459 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4460 <sup>87</sup>	N	N	N	N
4461 <sup>91*</sup>	N	N	N	S
4462 <sup>90</sup>	removed from census - low occupancy <sup>1</sup>			
4463 <sup>90</sup>	removed from census - low occupancy <sup>1</sup>			
4464 <sup>90</sup>	removed from census - low occupancy <sup>1</sup>			
4465 <sup>90*</sup>	N	N	N	N
4466 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
4467 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			♂
4468 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
4469 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>		♀ L	♀
4470 <sup>87</sup>	N	N	N	N
4471 <sup>87</sup>	removed from census - low occupancy <sup>1</sup>			
4472 <sup>87</sup>	N	N	N	N
4473 <sup>87</sup>	N	N	N	N
4474 <sup>86</sup>	P	N	N	N

Spruce-Fir Non Construction Area (SFN), 2003				
Midden	Mar	Jun	Sep	Dec
4475 <sup>87</sup>	located off-area, new number - 5405			
4476 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4477 <sup>87</sup>	N	N	N	N
4478 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
4479 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
4480 <sup>90*</sup>	removed from census - low occupancy <sup>1</sup>			
4481 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4482 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4483 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4484 <sup>86</sup>	N	N	N	N
4485 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4486 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
4487 <sup>86</sup>	located off-area, new number - 5487			
4488 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
4489 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
4490 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			♀
4491 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			♂
4492 <sup>91*</sup>	N	N	N	N
4493 <sup>91*</sup>	removed from census - low occupancy <sup>1</sup>			
4494 <sup>91*</sup>	N	N	N	N
4495 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
4496 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
4497 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
4498 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
4499 <sup>93*</sup>	removed from census - low occupancy <sup>1</sup>			
# Mid	25	25	27	32
# Occ	1	0	4	11
% Occ	4	0	15	34
# Sq	1	0	4	11



Table 2 - SFN (cont.)

- 1 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 2 Male at midden 4435 has a natural mark. It's a small triangle shaped notch on the back of the right ear.
- 3 Male at midden 4449 has a natural mark. There are apparent scars or patches of missing fur on his left shoulder and the left side of his face.

Off-Area Midden Occupancy, 2003				
Midden	Mar	Jun	Sep	Dec
TRC Area				
5101 <sup>89</sup>	♂ (W/W) 2	P	♂ (R/O RC) 10	♂ (R/O RC)
5102 <sup>98*</sup>	N	N	P	P
5103 <sup>99*</sup>	N	N	N	N
5104 <sup>99*</sup>	N	N	N	N
5105 <sup>02*</sup>	N	N	N	N
5106 <sup>02</sup>	N	N	N	♂
5107 <sup>02</sup>	N-XX 3	P	N	N
5114 <sup>89</sup>	removed from census - low occupancy 1			
5118 <sup>94*</sup>	♀ (-/G RC) 4	♀ (G/G RC)	♀L (G/G RC) + 2 11	♂ (Y/R) 11
5119 <sup>89*</sup>	N	♂ (P/O RC)	♂ (W/- RC) 12	♂ (W/- RC)
5120 <sup>89*</sup>	removed from census - too far off area			
5121 <sup>89*</sup>	♂ (G/- RC) 5	♂ (G/W RC)	N	♀ (B/W RC) 13
5122 <sup>89</sup>	N	N	N	N
5123 <sup>89</sup>	removed from census - too far off area			
5124 <sup>90*</sup>	removed from census - too far off area			
5125 <sup>89*</sup>	N	N	N	N
5126 <sup>91</sup>	N	N	N	N
5127 <sup>95*</sup>	removed from census - low occupancy 1			
5145 <sup>91*</sup>	N	N	N	N
5150 <sup>91*</sup>	N	P	N 11	N
5155 <sup>93*</sup>	♂ (W/- RC) 6	♂ (W/- RC)	P	P
5157 <sup>93*</sup>	N	N	N	N
TRN Area				
5200 <sup>93*</sup>	♀ (Y/W) 7	♀ (Y/W RC)	♀ (Y/W RC)	♀ (Y/W RC)
5201 <sup>99*</sup>	removed from census - low occupancy 1			
5202 <sup>99*</sup>	N	N	N	N
5203 <sup>00*</sup>	N	N	N	N
5221 <sup>91*</sup>	♂ (R/W RC)	♀ (Y/P RC) 9	♀ (Y/P RC)	♀ (Y/P RC)
5231 <sup>96*</sup>	N	N	N	P
5232 <sup>96*</sup>	N	N	N	♂

Off-Area Midden Occupancy, 2003				
Midden	Mar	Jun	Sep	Dec
SFC Area				
5302 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
5311 <sup>95*</sup>	N-XX <sup>8</sup>	N	♂	♂
5313 <sup>95*</sup>	N	N	♂	S
5350 <sup>86</sup>	N	N	P	♀ (B/- RC) <sup>14</sup>
5351 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			♂
5352 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
5353 <sup>94*</sup>	removed from census - too far off area			
5354 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
5355 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
5356 <sup>94*</sup>	removed from census - low occupancy <sup>1</sup>			
5357 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
5358 <sup>95*</sup>	removed from census - too far off area			
5359 <sup>95*</sup>	N	N	N	N
5360 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
5361 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			♂
5362 <sup>96*</sup>	removed from census - low occupancy <sup>1</sup>			
5376 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			
5377 <sup>87</sup>	N	N	N	N
5388 <sup>92*</sup>	removed from census - low occupancy <sup>1</sup>			
SFN Area				
5405 <sup>87</sup>	N	N	N	N
5410 <sup>95*</sup>	removed from census - low occupancy <sup>1</sup>			
5413 <sup>95*</sup>	N	N	N	N
5475 <sup>86</sup>	located on area - new number 4021			
5487 <sup>86</sup>	removed from census - low occupancy <sup>1</sup>			

Table 2 - Off Area (cont.)

- 1 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 2 The female (R/G) that was residing with male (W/W), at midden 5101 in December 2002, has not been observed at midden 5101 for some time and her fate is undetermined.
- 3 The female (O/W RC), former resident of midden 5107, was observed being eaten by a gray fox on the west side of Swift Trail road on 24 Feb 03. Her body and collar were collected after the fox dropped it upon being startled by the observer.
- 4 This animal's left ear tag has been lost. The ear tag combination was formerly G/G.
- 5 This animal's right ear tag has been lost. The ear tag combination was formerly G/W.
- 6 This animal's right ear tag has been lost. The ear tag combination was formerly W/B.
- 7 The body of female (O/R), former resident of midden 5200, was found at the base of the nest snag on 13 Jan 03. Subadult female (Y/W) was seen in the midden and nest snag during the same observation and was determined to be resident of 5200 during the March census.
- 8 The remains of the female (G/O RC), former resident of midden 5311, were found south of the study area on 24 Jan 03.
- 9 Female (Y/P RC) moved from midden 1104 to midden 5221 between the March and June censuses.
- 10 Male (R/O RC) moved from midden 1162 to midden 5101 between the June and September censuses.
- 11 Female (G/G RC) had a maternity nest near midden 5150 (2 juveniles seen there 7 Sep 03), but there was more feeding sign centered around midden 5118 and telemetry data supports her residence there for September. The radio collar of this female (G/G RC) was found on 6 Dec 03, on the ground near a nest snag. There was no definitive sign of predation, and her fate is undetermined. By the end of the December census, several observations indicated a subadult male (Y/R) was the new resident in midden 5118.
- 12 Male (P/O RC), resident of midden 5119 in June, moved to off-area midden 8034 (near the old prison camp). His collar was found in a nearby pack rat midden on 25 Sep 03, and his fate is undetermined. By the September census, male (W/-- RC) had changed his residence from midden 5155 to 5119. There was still some feeding sign at midden 5155, but telemetry data indicated the male (W/-- RC) was spending the most time in September at midden 5119.
- 13 Female (B/W RC) moved from midden 1115 to midden 5121 between the September and December censuses.
- 14 Female (B/--(R) RC ), moved from 3311 to midden 5350 between the September and December censuses.

Appendix B-2: New activity areas on the monitored areas in 2003.

There were no new activity areas located on any of the monitored areas in 2003.

Appendix C. Occupancy status of middens located within 100 meters of construction (telescopes or access road), 2003. These middens are checked during months other than the quarterly full census months (Mar, Jun, Sep, Dec) in which there is construction activity. These middens are checked as an “early warning” indicator of a large population decrease in between the quarterly censuses. See Table 2 for key to symbols.

Middens within 100m of construction												
Mid #	Jan	Feb	Mar <sup>1</sup>	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1160	♀ (R/R RC)	♀ (R/R RC) <sup>4</sup>	♀ (R/R RC)	♀ (R/R RC)	♀ (R/R RC) <sup>6</sup>	♀ (R/R RC)	♀ (R/R RC) <sup>9</sup>	P	P	N	N	N
1179	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3003	removed from census - low occupancy <sup>2</sup>											
3013	removed from census - low occupancy <sup>2</sup>											
3014	removed from census - low occupancy <sup>2</sup>											
3019	removed from census - low occupancy <sup>2</sup>											
3020	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3024	removed from census - low occupancy <sup>2</sup>											
3026	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3027	removed from census - low occupancy <sup>2</sup>											
3028	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3030	removed from census - low occupancy <sup>2</sup>											
3031	removed from census - low occupancy <sup>2</sup>											
3032	removed from census - low occupancy <sup>2</sup>											
3309	removed from census - low occupancy <sup>2</sup>											
3314	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3315	removed from census - low occupancy <sup>2</sup>											
3319	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3320	removed from census - low occupancy <sup>2</sup>											
3322	removed from census - low occupancy <sup>2</sup>											
3323	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	♂
3324	removed from census - low occupancy <sup>2</sup>											
3325	removed from census - low occupancy <sup>2</sup>											
3327	removed from census - low occupancy <sup>2</sup>											
3330	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3334	removed from census - low occupancy <sup>2</sup>											
3336	removed from census - low occupancy <sup>2</sup>											
3337	removed from census - low occupancy <sup>2</sup>											
3339	removed from census - low occupancy <sup>2</sup>											
3340	removed from census - low occupancy <sup>2</sup>											
3345	removed from census - low occupancy <sup>2</sup>											

Middens within 100m of construction												
Mid #	Jan	Feb	Mar <sup>1</sup>	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3346	removed from census - low occupancy <sup>2</sup>											
3347	removed from census - low occupancy <sup>2</sup>											
3350	removed from census - low occupancy <sup>2</sup>											
3354	removed from census - low occupancy <sup>2</sup>											
3357	removed from census - low occupancy <sup>2</sup>											
3362	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3363	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3364	removed from census - low occupancy <sup>2</sup>											
3365	N	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	Y	N	φ (P/R RC)
3368	removed from census - low occupancy <sup>2</sup>											
3379	removed from census - low occupancy <sup>2</sup>											
3382	P	- <sup>5</sup>	N	N	- <sup>7</sup>	N	- <sup>8</sup>	N	N	N	N	N
3383	removed from census - low occupancy <sup>2</sup>											
3385	removed from census - low occupancy <sup>2</sup>											
3389	removed from census - low occupancy <sup>2</sup>											
3391	removed from census - low occupancy <sup>2</sup>											
#	13	- <sup>5</sup>	13	13	- <sup>7</sup>	13	- <sup>8</sup>	13	13	13	13	13
# Occ	1	- <sup>5</sup>	1	1	- <sup>7</sup>	1	- <sup>8</sup>	0	0	0	0	2
%	8	- <sup>5</sup>	8	8	- <sup>7</sup>	8	- <sup>8</sup>	0	0	0	0	15
# Sq	1	- <sup>5</sup>	1	1	- <sup>7</sup>	1	- <sup>8</sup>	0	0	0	0	2

Table 3 (cont.)

- 1 A complete census of all areas is conducted in Mar, Jun, Sep, and Dec (see Table 2).
- 2 These middens have been removed from regular censusing due to low occupancy. These middens were unoccupied for at least 12 consecutive quarterly censuses (three years) prior to removal. All middens removed due to low occupancy are checked once per year (usually in December) for activity. Any middens that become reoccupied are added back to regular censusing.
- 3 The total number of middens does not include middens removed from censusing due to low occupancy. All middens are located on the SFC area, except for middens 1160 and 1179 which are located on the TRC area.
- 4 Female (R/R RC) at midden 1160 was tracked with radio telemetry throughout the month of February. Therefore it was possible to determine her residence at this midden.
- 5 The second monthly census of middens within 100 meters of construction was scheduled for the last week of February, but due to adverse weather conditions the crew was not able to collect data for this month.
- 6 Female (R/R RC) at midden 1160 was tracked with radio telemetry throughout the month of May. Therefore it was possible to determine her residence at this midden.
- 7 The fifth monthly census of middens within 100 meters of construction was scheduled for the second week of May, but there was not enough personnel to complete the census due to conference attendance throughout the month.
- 8 The seventh monthly census of middens within 100 meters of construction was scheduled for the second week of July, but due to lack of field time we were not able to complete it.
- 9 Female (R/R RC) at midden 1160 was tracked with radio telemetry throughout the month of July. Therefore it was possible to determine her residence at this midden.



Appendix D. Red squirrel populations (including juveniles still living at maternal middens) on the areas being monitored by the Red Squirrel Monitoring Program, from December 2002 through December 2003.

Date	TRC	TRN	SFC	SFN	TOTAL
Dec 2002	14	4	2	1	21
March 2003	11	4	2	1	18
June 2003	9	2	2	0	13
Sep 2003	7 + 7J	3	1 + 4J	4	26
Dec 2003	11	6	8	11	36

Appendix E: Midden Occupancy Maps, 2003.

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**

<b>DATE</b>	<b>TRC</b>	<b>TRN</b>	<b>SFC</b>	<b>SFN</b>
Area <sup>1</sup> (after Jan 2000)	51.1 ha	21.0 ha	76.0 ha	104.4 ha
Dec 2002	0.78	1.95	0.82	0.35
Mar 2003	0.72	1.67	0.43	0.24
Jun 2003	0.72	1.67	0.43	0.24
Sep 2003	0.72	1.67	0.45	0.26
Dec 2003	0.72	1.67	0.47	0.30

**Appendix F-1b: Crude Density of Red Squirrels**

<b>DATE</b>	<b>TRC</b>	<b>TRN</b>	<b>SFC</b>	<b>SFN</b>
Area <sup>1</sup> (after Jan 2000)	(51.1 ha)	(21.0 ha)	(76.0 ha)	(104.4 ha)
Dec 2002	0.27	0.19	0.03	0.01
Mar 2003	0.22	0.19	0.03	0.01
Jun 2003	0.18	0.10	0.03	0.00
Sept 2003	0.27	0.14	0.07	0.04
Dec 2003	0.22	0.29	0.11	0.11

<sup>1</sup> The new area sizes for 2000 and afterwards are the result of more accurate GPS mapping of features on the monitored areas. The greatest change occurred on the SFN area - this was mainly due to more accurate mapping of the northern boundary (a Forest Service hiking trail).

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

<b>TRC Area</b>										
<b>Middens</b>						<b>Squirrels</b>				
Month	# Mid	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	# RS	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 02	40	5.9	0.44	41.5	2.63	14	2.3	0.38	62.2	7.75
Mar 03	37	6.0	0.46	42.0	2.81	14	2.3	0.38	62.2	7.75
Jun 03	37	5.6	0.47	42.3	2.86	9	1.4	0.44	81.3	14.61
Sep 03	37	5.5	0.46	42.4	2.89	7	2.0	0.44	81.0	22.87
Dec 03	37	5.6	0.47	42.3	2.86	11	1.8	0.30	81.2	12.68

<b>TRN Area</b>										
<b>Middens</b>						<b>Squirrels</b>				
Month	# Mid	Mean local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	# RS	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 02	41	5.9	0.44	41.0	2.10	4	1.3	0.63	108.5	26.28
Mar 03	35	6.4	0.31	40.7	2.35	4	1.3	0.63	108.5	26.28
Jun 03	35	5.5	0.30	44.3	2.84	2	1.5	1.50	153.6	73.47
Sep 03	35	5.6	0.28	44.3	2.85	3	1.3	0.33	75.5	7.89
Dec 03	35	5.5	0.30	44.3	2.84	6	0.7	0.33	107.4	10.06

## Appendix F-2 (con't.)

<b>SFC Area</b>										
<b>Middens</b>						<b>Squirrels</b>				
Month	# Mid	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	# RS	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 02	62	3.5	0.21	59.2	3.28	2	0	0	104.4	0
Mar 03	33	3.6	0.27	57.2	2.76	2	0	0	108.5	26.28
Jun 03	33	2.1	0.19	69.3	5.31	2	0	0	104.4	0
Sep 03	34	2.3	0.20	66.5	5.24	1	0	0	224.14	0
Dec 03	36	2.3	0.19	65.5	5.01	8	0.6	0.26	116.0	20.38

<b>SFN Area</b>										
<b>Middens</b>						<b>Squirrels</b>				
Month	# Mid	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	# RS	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 02	37	1.3	0.18	85.0	8.78	1	0	0	1146.7	0
Mar 03	25	1.4	0.18	73.4	5.57	1	0	0	1146.7	0
Jun 03	25	0.9	0.12	88.0	8.70	0	0	0	0	0
Sep 03	27	0.9	0.11	88.4	10.16	4	0	0	390.0	67.18
Dec 03	32	1.3	0.16	83.7	8.58	11	0.4	0.15	161.9	36.09

## Appendix F-2 (con't.)

<b>All Areas Combined</b>										
<b>(including off-area middens within 100m of middens on the monitored areas)</b>										
<b>Middens</b>						<b>Squirrels</b>				
Month	# Mid	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean	# RS	Mean Local Dens.	Std. Error of the Mean	Mean Nearest Neighbor Dist (M)	Std. Error of the Mean
Dec 02	211	4.4	0.19	56.4	2.27	31	1.9	0.29	117.4	35.27
Mar 03	160	4.7	0.23	52.5	1.81	31	1.9	0.29	117.4	35.27
Jun 03	160	3.9	0.23	58.3	2.49	19	1.2	0.29	115.8	22.92
Sep 03	163	3.9	0.22	58.2	2.66	22	0.9	0.24	188.7	36.31
Dec 03	172	3.9	0.21	57.7	2.49	49	0.9	0.13	111.5	11.05

Appendix G: Reproductive success on the monitored areas, 2003.

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

G-2: Litters seen on the monitored areas.

G-3: Reproductive status and age statistics by census quarter.



## Appendix G-1: Breeding Chases Observed - 2003

Descriptions of mating chases observed in 2003. Chases at middens outside the UA monitored areas are noted as they involved squirrels resident on the monitored areas.

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
30 Apr 03	5118	Saw mating chase between resident 5118 female (G/G RC) and male resident of 5155 (W/- RC). The male was mostly doing the chasing, all throughout the trees in the area. For much of the time, the chaser was making a low, growling, buzzing noise. He chased her aggressively for several minutes then, at one point, they stopped on a branch and sat facing each other while 5155 male growled and both groomed for a short while. Then they took off again in another aggressive chase. After a minute or two, 5118 female took off north but 5155 male didn't follow her. Instead, he sat on a branch near her midden and groomed a little bit before taking off east.
02-May-03	ST-23	5155 male (W/- RC) captured at 8004/ST-23 today, was involved, along with 8008/ST-04 (Y/B RC) male and two other unmarked males, in mating chase of the unmarked female resident of 8004
12-May-03	near 1102	Discovered a large mating chase that involved at least 8 squirrels. Three females were observed being chased during this time. They were 1144 (P/W RC), 2208 (W/G RC), and 1102 (W/O RC). The males seen were 8008/ST-04 (Y/B RC), 5121 (G/W RC), 5155 (W/B RC), 5101 W/W (no RC sub-adult), and one unmarked scrotal male. During the two hours of observation, the squirrels were all almost constantly "buzzing". There would be periods of intense chasing, a pause for 10-15 minutes, and then the chasing would continue. No copulations or attempted copulations were observed.
13-May-03	5118	A breeding chase was observed around midden 5118 between the male from 1118 (Y/Y RC), and the female from 5118 (G/G RC). The actual chasing did not last very long. After about 10 minutes of chasing, 5118 female proceeded to groom herself extensively while 1118 male just sat on a branch. Very little buzzing occurred during the chase, it was only heard once. After the brief chasing stopped, the female moved off and fed for the remainder of the observation.

## Appendix G-1: (cont.)

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
05-Jun-03	8046 shift	On the ST area west of UA monitored area. Potential mating chase. Saw 5155 male (W/- RC) and 1118 male (Y/Y RC) chase an unknown female. Heard buzzing, chattering, squeaking ,and bark/chuck vocalizations.
17-Jun-03	BC-44	Just NE of TRN area , north side of Bible Camp Road. Observed a mating chase all around BC-44 involving at least three unmarked animals plus two marked animals: Unknown residence male (R/Y RC) and 1177 male (O/G RC). Lots of vocalizations, mostly buzzing, but some chattering also.

## Appendix G-2: Litters seen on the monitored areas.

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
22 Aug 03	1103	Four juveniles confirmed with mother (O/- RC). Seen playing on and near nest 11081 near midden 1103. These juveniles may emerged from the nest about a week or so before, as they were seen peeking out from, but not exiting, on 7 Aug 03. One male juvenile was live trapped at the base of the nest and tagged (M/M), he was later live trapped as a resident at midden 1102 and re-tagged (G/R).
24 Aug 03	1115	Four juveniles confirmed with mother (B/W RC) at nest 11066 near midden 1115. These juveniles were fairly small and not ranging far from the nest snag. It is possible that these juveniles emerged from the nest less than a week prior. The mother was observed moving (carrying in mouth) them from a ground nest to a snag nest on 8 Aug 03.
24 Aug 03	1163	Five juveniles confirmed with their mother (R/R RC) at nest 11018 near midden 1163. The juveniles were first seen on 25 Jul 03, when they were very small and only peeking out of the nest cavity 11076. They were first seen out of the nest on 18 Aug 03, however based on their size and mobility, they may have emerged from the nest a couple of weeks earlier. Two juveniles (1 male, 1 female) from this litter were live-trapped and ear-tagged (M/M). The female was later recaptured as resident at midden 1131 and re-tagged (R/G).
7 Sep 03	5118	Two older juveniles were seen with their mother (G/G RC), at a maternity nest (15105) near midden 5150. The juveniles were quite large, agile, and ranging from the nest. They likely emerged from the maternity nest a few weeks earlier.
8 Sep 03	3311	Four juveniles confirmed with their mother (B/- RC) at nest 13112. By size and mobility, these juveniles may have emerged from the nest a couple of weeks prior. Two male juveniles were live trapped at the maternity nest and tagged (M/M). One male was recaptured as resident of midden 3348 and re-tagged (O/O).

Appendix G-3:

Reproductive status and age information for squirrels on or near the monitored areas, for quarterly census months, 2003. Only information on the final resident each month is given. Middens that were determined to be active based on sign alone and no squirrel was seen are not included. Information gathered on squirrels determined to be non-residents at a midden is also excluded. Therefore the total number of active middens for a given month may be higher than the totals of the numbers seen here. **Information for off-area middens (5000s) is included in Table 1a-c.** Information on reproductive condition is taken from trapping records or visual assessment if no trapping data is available.

Appendix G-3a: Female reproductive information

Reproductive Status	March		June		September		December	
	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	Unkn.
reproductive <sup>2</sup>			6					
lactating <sup>2</sup>			1		7			
recent lactation <sup>2</sup>					3		7	
past lactation <sup>2</sup>	9						2	
non-reproductive <sup>1</sup>	3		1					5
unknown		1	3		1		1	1

1 YOY = Young of year, squirrels that have left the maternal midden. Identified by visual cues: generally smaller size, whiter fur on underside, thinner tail, head may appear slightly large (out of proportion). Young of the year are by definition not reproductively mature.

2 Reproductive may indicate estrus or pregnancy. Lactating indicates current lactation, milk expressed or other visual cues. Recent lactation includes females that have lactated in the current breeding season. Past lactation indicates lactation in a previous breeding season (at least 1 year prior).

Appendix G-3b: Male reproductive information. Average testis length for each month includes measurements on adult and young of year males. Only the first measurement of the month was used if there were multiple captures.

Reproductive Status	March		June		September		December	
	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>
scrotal	9		7		8		5	
partially scrotal								2
non-reproductive <sup>1</sup>							4	9
unknown		1	1		2			2
Average Testis Length (mm)	(n = 8) 24.1		(n = 6) 25.3		(n = 5) 9.8		(n = 4) 10.0	

Appendix G-3c: Age information for final monthly resident females, males, and squirrels of unknown sex combined

March		June		September		December	
Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>	Adult	YOY <sup>1</sup>
21	2 <sup>2</sup>	19	1	21	1	19	9

1 YOY = Young of year, squirrels that have left the maternal midden. Identified by visual cues: generally smaller size, whiter fur on underside, thinner tail, head may appear slightly large (out of proportion). Young of the year are by definition not reproductively mature. Juveniles caught at natal middens and positively identified may be included in these numbers.

2 These two animals were determined, by examination during trapping, to be young of the year from 2002.

## Appendix H. Monthly weather summaries - January through December, 2003.

Note: Averages are calculated based on the total number of records collected per month. Weather stations are averaging data at 1 hour intervals producing approximately 600 to 700 records per month.

	Month	Biology Camp	Emerald Peak
Temperature (°C) average (max; min)	January	1.9 (11.9; -6.6)	0.6 (9.9; -8.3)
	February	-2.1 (10.0; -10.1)	-3.8 (6.8; -11.8)
	March	-0.7 (10.7; -11.4)	-2.1 (10.1; -13.6)
	April	3.0 (12.9; -7.4)	1.2 (10.2; -9.8)
	May	9.5 (21.6; -2.9)	7.8 (18.1; -4.6)
	June	13.2 (22.7; 3.8)	11.7 (20.1; 1.8)
	July	15.8 (27.6; 6.8)	14.3 (24.9; 6.3)
	August	13.4 (22.7; 7.0)	12.1 (21.6; 6.1)
	September	11.7 (20.6; 3.9)	10.4 (17.8; 4.8)
	October	9.0 (19.4; -1.7)	7.4 (16.9; - 4.3)
	November	2.4 (13.5; - 6.9)	0.9 (10.9; -8.2)
	December	-0.4 (12.6; - 15.3)	- 1.9 (9.8; - 17.1)

	Month	Biology Camp	Emerald Peak
Wind Speed (m/sec), maximum(max. gust)	January	3.6 (12.5)	4.9 (14.8)
	February	3.1 (11.6)	2.2 (13.9)
	March	2.7 (11.6)	2.2 (9.8)
	April	2.7 (12.1)	2.7 (10.3)
	May	2.2 (9.8)	3.1 (12.1)
	June	1.8 (8.9)	2.2 (9.8)
	July	2.2 (9.4)	1.8 (8.9)
	August	1.3 (114.0)	1.8 (6.7)
	September	2.2 (7.2)	4.0 (11.2)
	October	1.8 (8.9)	1.8 (11.2)
	November	3.1 (10.7)	2.2 (11.2)
	December	3.1 (15.2)	2.7 (14.3)
Wind, Most Common Direction	January	N	N
	February	S	N
	March	N-NE	N
	April	S-SW	NW
	May	S-SW	N
	June	NE	N
	July	NE	N
	August	NE	N
	September	SW	N
	October	SW	N
	November	S-SW	SE
	December	SW	N

	Month	Biology Camp	Emerald Peak
Maximum Snow Depth (cm) Forest/Clearing	January	44/46	35/41
	February	68/92	108/108
	March	74/105	125/119
	April	0/11	85/38
	May		
	June		
	July		
	August		
	September		
	October		
	November		
	December	10/13	
Rain Fall (mm) Total	January	- <sup>1</sup>	- <sup>1</sup>
	February	- <sup>1</sup>	- <sup>1</sup>
	March	- <sup>1</sup>	- <sup>1</sup>
	April	- <sup>1</sup>	- <sup>1</sup>
	May	- <sup>1</sup>	- <sup>1</sup>
	June	2.0	1.0
	July	70.2	67.6
	August	42.2	52.4
	September	31.8	35.2
	October	11.8	17.4
	November	49.6	72.8
	December	- <sup>2</sup>	- <sup>2</sup>



	Month	Biology Camp	Emerald Peak
Relative Humidity (%) average (max; min)	January	48.0 (100.0; 11.0)	38.1 (96.0; 5.0)
	February	66.9 (100.0; 10.0)	61.6 (95.0; 4.0)
	March	63.4 (98.0; 16.0)	55.7 (95.0; 7.0)
	April	45.8 (99.0; 14.0)	40.2 (95.0; 7.0)
	May	39.3 (94.0; 11.0)	33.7 (91.0; 7.0)
	June	37.9 (85.0; 16.0)	30.3 (81.0; 6.0)
	July	57.3 (100.0; 15.0)	49.8 (96.0; 9.0)
	August	77.2 (100.0; 42.0)	69.4 (97.0; 28.0)
	September	65.8 (100.0; 28.0)	57.0 (98.0; 21.0)
	October	56.9 (100.0; 20.0)	52.2 (97.0; 15.0)
	November	51.4 (100.0; 9.0)	44.2 (97.0; 3.0)
	December	45.1 (99.0; 9.0)	38.4 (94.0; 2.0)
Dew Point (°C) average (max; min)	January	-9.3 (1.5; -25.1)	-14.8 (-0.5; -34.8)
	February	-8.9 (1.9; -30.2)	-12.3 (0.1; -39.4)
	March	-7.9 (0.40; -20.6)	-11.8 (-1.1; -31.5)
	April	-8.6 (3.8; -24.5)	-12.3 (1.1; -32.6)
	May	-5.0 (10.5; -21.7)	-8.9 (8.8; -29.7)
	June	-1.6 (11.6; -14.7)	-6.1 (6.8; -26.0)
	July	5.9 (15.6; -7.5)	2.0 (12.3; -14.0)
	August	9.2 (16.8; 3.9)	6.2 (11.8; 1.0)
	September	4.8 (13.6; -4.7)	1.2 (10.9; -11.3)
	October	-0.2 (10.4; - 18.3)	- 3.3 (7.6; - 22.3)
	November	- 8.8 (5.4; - 31.2)	- 13.7 (3.5; - 44.4)
	December	- 13.2 (0.3; - 31.3)	- 18.3 (- 2.4; - 42.4)

- 1 The rain gauges were disconnected on 31 Oct 02. All moisture during the months of January and February 2003 was in the form of snow. The rain gauges were reconnected on 8 Jun 03.
- 2 The rain gauges were disconnected on 6 Dec 03 and will be reconnected in the spring after the snow melt.

Appendix H-2. Monthly maxima, minima and averages for accumulated snow depth. Data are from snow poles in Spruce-Fir (SF) and Mixed Conifer (TR) habitats from locations in the forest (F) and in clearings (C).

Month	Hab	Loc	N <sup>1</sup>	Average snow depth (cm)	Maximum snow depth (cm)	Minimum snow depth (cm)
Dec 2002	TR	C	5	25.0	36	16
Dec 2002	TR	F	4	21.0	31	14
Dec 2002	SF	C	4	28.8	47	19
Dec 2002	SF	F	5	17.6	28	13
Jan 2003	TR	C	5	33.8	46	8
Jan 2003	TR	F	4	31.3	44	24
Jan 2003	SF	C	4	31.5	51	2
Jan 2003	SF	F	3	29.3	35	18
Feb 2003	TR	C	6	65.2	105	26
Feb 2003	TR	F	6	53.2	93	20
Feb 2003	SF	C	6	82.0	134	43
Feb 2003	SF	F	4	91.0	108	67
Mar 2003	TR	C	5	92.2	115	67
Mar 2003	TR	F	6	70.7	105	42
Mar 2003	SF	C	8	104.8	145	58
Mar 2003	SF	F	7	91.1	125	42
Apr 2003	TR	C	3	15.7	36	0
Apr 2003	TR	F	3	17.0	51	0
Apr 2003	SF	C	2	19.0	38	0
Apr 2003	SF	F	2	42.5	85	0

- 1 There are 8 sets of snow poles (a set = 1 forest and 1 clearing) on the monitored areas: 3 in the TR habitat and 5 in the SF habitat. Due to weather and other duties, often only a subset of poles are read throughout the month