

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

2004 Annual Report

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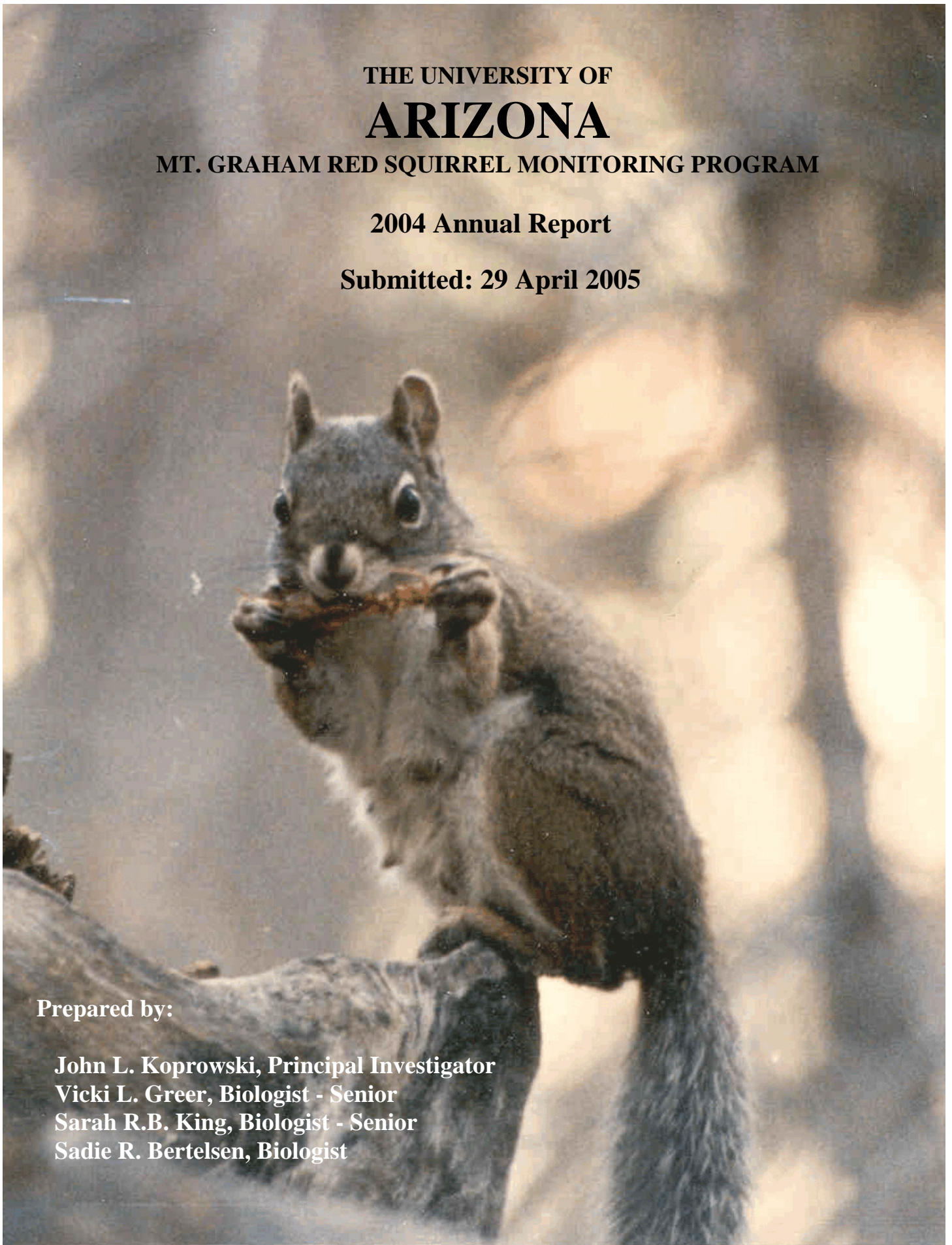


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INTRODUCTION

The Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) is the southernmost subspecies of the wide-ranging red squirrel and is endemic to the Pinaleño (Graham) Mountains of southeastern Arizona (Hoffmeister 1986). Believed restricted to ≤ 12200 ha of mixed-conifer and spruce-fir forest at elevations > 2360 m (Hatten 2000), Mt. Graham red squirrels were federally protected as endangered in 1987 with critical habitat defined in 1990 and a recovery plan published in 1993 (United States Fish and Wildlife Service 1993). The University of Arizona's Mt. Graham Red Squirrel Monitoring Program (RSMP) was established in 1989 to meet the requirements of the Mount Graham International Observatory (MGIO) Management Plan (USDA Forest Service 1989) by monitoring the population of this endangered species in the highest peaks of the Pinaleño Mountains near the MGIO ($32^{\circ} 42' N$, $109^{\circ} 53' W$). In 2004, 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 activities at the Large Binocular Telescope (LBT) in 2004 were mainly interior building work. Herein, we report on the monitoring efforts from 1 January to 31 December 2004.

The Nuttall Fire Complex began as two lightning started fires on 22 Jun 04 (Gibson Fire) and 26 Jun 04 (Nuttall Fire) and the two fires merged on 2 Jul 04. The fire perimeter covered most of the northeast half of the Pinaleño range at elevations from 1371m to the highest point in the range, Mt. Graham at 3267m. The fires were contained after 19 Jul 04, and the USFS Burned Area Response Team estimated the total fire size at 12029 ha. For detailed information about the impacts of the Nuttall Fire on the RSMP study areas see Appendix H.

All use of 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.

STUDY AREA

Four areas were defined in the vicinity of the MGIO to monitor red squirrel populations (Figure 1) and include two forest habitat types: transitional (TR) or mixed conifer forest and spruce-fir (SF) forest. The TR habitat, between 2680 and 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, ≥ 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 (TRC, SFC). For comparison, a *non-construction* area beyond 300 m from the MGIO or the access road was defined in each habitat (TRN, SFN). The size of monitored areas has changed several times due to construction and fire events (Table 1).

METHODS

Red squirrels cache conifer cones in locations known as middens. Middens are easily recognized by presence of cached cones and piles of discarded cone scales. The RSMP defines a midden site as a circular area with 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 no improvement occurs in the two quarterly censuses following initial location, the activity area is 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, the midden is removed from the list for regular censusing and are revisited only in December. If any of removed middens become re-occupied, the sites are returned to the list for regular census. In 2003, because a large number of middens were removed in some areas as a result of insect damage, we began visiting all removed middens during each census. 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.

Red Squirrel Food Resources

Conifer Seed Production

The RSMP began collecting quantitative data in 1993 to determine the abundance of major red squirrel food resources: conifer seeds and mushrooms. Seed production for 2003 was estimated from 28 seedfall plots distributed among the monitored areas (Figure 1). Three 0.25 m² seed traps were randomly placed within a 10 m x 10 m plot at each location. Seeds from the 2003 crop were collected from the seed traps in Jun 2004. Conifer seeds contained in each trap were separated by species and individually tested 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 total number of viable seeds because some seeds may have been preyed upon within the seed trap. Estimates of seedfall for each tree species were calculated as the average number of viable seeds from all three traps on each plot. Seeds of white pine and ponderosa pine are not readily dispersed by wind due to their large size. As a result, seed crops of these species are under represented in seed trap samples. Both species may be important local food supplies for red squirrels, but at present no reliable method exists to estimate size of seed crops.

Mushroom Production

As in previous years, mushrooms were collected from plots 1m by 100m (0.01 ha) at two week intervals during periods of mushroom production. Eleven of 28 food resource plots were destroyed in the Nuttall Fire, however, three new plots were established in remaining unburned areas on the SFC and SFN. Mushrooms (epigeous or above-ground fungi) were collected at these 20 sites (Figure 1) from July through September 2004. In 2004, 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. We detected no significant differences in weight, number, or diversity of mushrooms between the two orientations; we decided to use east-west plots for several years and avoid overharvest of the north-south plots. Collections were restricted to genera of mushrooms used by red squirrels on Mt. Graham or in other regions (Table 2). Collected mushrooms were separated by plot and genus, and weighed wet. For most genera, dry weight was calculated by multiplying wet weight by a wet weight/dry weight ratio determined from previous samples on Mt. Graham. Dry weights were measured directly for genera with small numbers of specimens previously collected (<50).

Because seeds for a given year are not collected and analyzed until the following spring, seed data are delayed by one year. 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 number and distribution of occupied middens on each monitored area. In March, June, September, and December 2004, all middens were visited at least once to determine occupancy. If a midden appeared to be occupied based upon feeding sign (cone scales, dried mushrooms, and conifer clippings) or caching, every attempt was made on subsequent midden visits to observe the resident and to determine its sex, age, and reproductive condition. In 2004, most animals on or near monitored areas were ear-tagged and many were fitted with radio collars, further assisting census efforts.

All middens on the monitored areas were classified as either occupied, unoccupied, or possibly occupied, with each occupied midden representing one squirrel (except for females with dependant juveniles). A midden was considered unoccupied when no squirrel or squirrel sign was present. A midden was considered possibly occupied when red squirrel sign was found but 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 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 2003, the number of occupied middens and the identity of resident squirrels were determined. December 2003 occupancy was compared to occupancy for June 2004. For unmarked animals, a squirrel was considered to have survived 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 surviving individual. For marked squirrels, survival was generally known with a fair degree of certainty using available trapping and telemetry information.

Spatial Distribution

We used three methods to describe 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. We made no allowance for differences in habitat quality among 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*. 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 measurements 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) and is also 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 (m) from a focal *midden* or *squirrel* to the nearest *midden* or *squirrel*. 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 using mapped coordinates and compared among areas and habitats using ANOVA. To determine the LD and NND of some middens and squirrels on the monitored areas, we included off-area middens within 100 m of a focal midden.

Reproductive Activity and Success

In 2004, we recorded breeding condition of adult male and female squirrels, and litter size when observed. By examining the squirrel's condition through trapping efforts or binoculars, we determined the reproductive status of a female as non-reproductive (small unpigmented teats), reproductive (vulva visibly swollen or appearance of pregnancy), lactating (swollen, elongated teats with surrounding alopecia), recently lactating (elongated black tipped teats), or lactating in past seasons (small black tipped teats). We determined reproductive status of male squirrels during trapping or visual assessment as testes non-scrotal (non-reproductive) or testes scrotal (reproductive).

Trapping and Marking

In accordance with Federal Fish and Wildlife Permit #TE041875-1, using accepted methods (Koprowski 2002), we trapped red squirrels using Tomahawk wire-mesh box-type live traps, baited with peanuts, peanut butter, apples, mushrooms, or cones. Once captured, we transferred squirrels to a cloth-handling cone for marks and measurements. We tagged squirrels with small numbered metal ear-tags threaded with colored plastic washers and affixed to ears for easy distance identification. We also fitted some adult animals with radio collars. Squirrels were normally released within 2-3 minutes of transfer to the cloth-handling bag and 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 ± 5 m. Universal Transverse Mercator (UTM) coordinates from GPS files were used to compute local densities and nearest neighbor distances. 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 location 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 Arc-View 3.2 (ESRI 1995).

Weather Data

Weather data were collected using two Davis Instruments weather stations. One station was located along the abandoned Forest Service road north of Emerald Peak on the SFC; the other was located at the Biology Camp on the TRC. Stations record air temperature (high, low, and average), wind speed, wind direction, rainfall, relative humidity and barometric pressure. Data were averaged at 60-min intervals. In 2004, due to equipment problems and the dismantling of the stations during the Nuttall Fire, data were unavailable from May through September. However, data from the

RAWS station at Columbine work camp (approx. 1km NE of biology camp) were obtained for this period and used for TR weather summaries. Snow depth (cm) was recorded from four snow pole pairs located in SF habitat, one pair at the 3050 m level on the access road, and three snow pole pairs in TR habitat. Each pair consists of a pole in a clearing or canopy opening and a second pole nearby in the forest.

All statistical analyses were conducted using standard tests found in SAS and/or Minitab statistical software. The significance level for all tests was $P \leq 0.05$, unless otherwise noted.

RESULTS

Red Squirrel Food Resources

2003 Conifer Seed Production

The total 2003 seed crop was fifth highest on the monitored areas since data collection began in 1993. Corkbark fir was the most abundant seed in 2003. When comparing the 2003 seed crop to all previous years of study for each species, corkbark fir was the second highest reported seed crop, Douglas-fir was fourth highest reported seed crop, and Engelmann spruce was also fourth highest reported seed crop. The 2003 overall seed crop was 33 times higher than the seed crop in 2002 (Table 3, Figures 2a-c, Appendix A).

2004 Mushroom Production

Overall annual mean mushroom production in 2004 was approximately 30% greater than in 2003, but was the second lowest since data collection began in 1994. Production increased in TR habitat and slightly decreased in SF habitat in 2004 as compared to 2003 (Figure 3). In 2004, mushroom production (\bar{x} wet weight) was greater on TRC than on TRN. Production on SFC was greater than SFN (Table 4). On TRC, three genera, *Auricularia*, *Russula*, and *Cortinarius*, accounted for 86% of production. On TRN, *Leccinum*, *Cortinarius*, and *Auricularia* accounted for 85% of total production. *Lycoperdon*, *Clitocybe*, and *Cortinarius* accounted for 73% of the production on SFC. On SFN, *Russula*, *Lycoperdon*, and *Clitocybe* accounted for 90% of the total production (Table 5).

Population Biology

Midden Occupancy

Four quarterly censuses (Mar, Jun, Sep, and Dec) of all middens on or near monitored areas were made in 2004 (Appendix B). From December 2003 to December 2004, the number of red squirrels dropped from 36 to 18, a 50% decrease. On TRC, the highest number of squirrels (12 Ad + 2J) was in September 2004, and the lowest number was 10 (8Ad + 2J) in June. December had the lowest number of squirrels (3 Ad) on TRN and highest numbers (5Ad + 3J) were in June. The highest number of squirrels on SFC was in March (8 Ad) with the lowest (3 Ad) in September and December. On SFN, the highest number of squirrels (9 Ad) was in June and the lowest (0 squirrels) in September and December (Figure 4, Appendix B, C, D). The squirrel populations in 2004 were some of the lowest observed on the monitored areas since data collection began in 1989 (Figure 5).

Twenty middens in the regular census were lost due to severe damage in the Nuttall Fire along with 94 other middens on or near the monitored areas (Appendix H-1a). Two newly established middens were added on the TRC area in December 2004 (Table 6). In June 2004, the proportion of middens occupied within TR or SF habitats did not differ. In December 2004, more middens were occupied on TRC than TRN, but SFC and SFN were similar (Table 6).

Overwinter Survival

The number of squirrels that survived the winter of 2003-2004 did not differ among all areas (Table 7); survival was 71% in TR habitat and 53% in SF habitat. For comparison, survival from the previous winter (2002-2003) was 61% in TR habitat and 33% in 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 less likely as more squirrels on the monitored areas are ear-tagged and radio-collared for unique identification.

Crude Density

Between December 2003 and December 2004, crude density of *middens* on the areas remained relatively unchanged, except SFN, which increased slightly, as middens that remained following the Nuttall Fire were concentrated in the small unburned area (Appendix E1-a). Crude density of *squirrels* on all areas decreased from December 2003 to December 2004. The TRC was the exception, with a slight increase from December 2003 to December 2004 (Appendix E1-b).

Local Density

The December 2004 overall mean local density (\bar{x} LD) of *middens* was slightly lower (3.4), than in December 2003 (3.7). Local density of middens differed among the four areas. The SFN had the lowest \bar{x} LD (1.1), and TRC had the highest \bar{x} LD (4.7). The mean \bar{x} LD of *squirrels* (occupied middens) on all areas in December 2004 was 1.1, which is an increase from 0.9 in December 2003. The \bar{x} LD of *squirrels* differed among areas as SFC was lowest \bar{x} LD (0.0) and TRC was highest \bar{x} LD (1.4) (Table 8, Appendix E-2).

Nearest Neighbor Distance

Overall \bar{x} NND of *middens* increased slightly from December 2003 to December 2004 (58.2 to 59.1m). The \bar{x} NND in SF habitat was longer than in TR habitat in December 2004 (Table 9, Appendix E-2). The \bar{x} NND of *squirrels* (occupied middens) for all areas decreased from 117.9m in December 2003 to 114.0m in December 2004. The \bar{x} NND of *squirrels* differed among areas as SFC was longest \bar{x} LD (311.8m) and TRC was shortest \bar{x} NND (68.9m) (Table 9, Appendix E-2).

Reproductive Activity and Success

Only one breeding chase was observed in 2004, on 5 April on TRC (Appendix F-1). Based on information from census and trapping records, most resident adult males were scrotal from January through July. No scrotal males were noted in August through November, but a few males became scrotal in December (Appendix F-3b).

The first lactating female was observed 20 May on TRN and the latest was on 2 September, on TRC. During the June census, of the 14 adult females identified as residents (including nearby off-area middens), 4 were reproductive and 6 were lactating. By September, of 9 resident females, 3 were lactating, and 4 were post-lactation (Appendix F-3a). Direct evidence of 9 litters (27 juveniles) was seen on or near the areas during censuses or other activities. The earliest litters were seen at the end of May in TR habitat, and the latest were seen in early September, also in TR habitat (Appendix F-2).

Trapping and Marking

Marked Squirrels

By the end of 2004, nearly all residents on or near monitored areas were fitted with colored ear tags and radio-collared (Appendix B). In addition, 7 juveniles were caught while still at natal middens and fitted with small numbered metal ear tags to aid in the collection of dispersal information.

Mapping

No significant changes in maps of the monitored areas were made in 2004, as all major features (middens, roads, trails, construction areas, etc.) have been mapped in previous years. New nests or habitat plots were GPS located and added to databases and maps.

Weather Data

Weather data were collected for most of 2004 from two weather stations located at the biology camp (TR habitat) and near Emerald Peak (SF habitat). The Nuttall Complex Fire resulted in a cessation of weather data collection during and immediately after the fire. From available data, maximum temperature recorded was 25.0°C in July at the biology camp and the minimum temperature recorded was -17.3°C in November on Emerald Peak. The maximum average monthly temperature was 13.9°C in July at the biology camp and the minimum average monthly temperature was -0.6°C in November also at biology camp (Appendix G-1). From data only in TR habitat, the maximum total monthly rainfall was recorded in July, at 33.2 mm and June was the driest month at 4.6mm (Appendix G-1). Snow depth was recorded from the eight pairs of snow poles. The average accumulated snow depth from December 2003 through April 2004 ranged from 10.0 cm to 175.4 cm (Appendix G-2). For comparison, average accumulated snow depths for December - Apr in 2002-2003 ranged from 0 cm to 104.8 cm, and in December - March 2001-2002, depths ranged from 0.0 cm to 30.7 cm. Data on wind chill temperatures, wind direction and speed, humidity, and barometric pressure were also collected (Appendix G-1).

Insect Outbreaks on the Monitored Areas

Infestations of bark beetles (*Drycoetes confusus* and *Dendroctonus rufipennis*) continued on parts of the monitored areas in 2004, 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.fs.fed.us/r3/resources/health/>

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Table 1. Changes in the areas monitored by the University of Arizona's Red Squirrel Monitoring Program as influenced by construction and fire events. TRC = transitional forest in the construction zone, TRN = transitional forest outside of the construction zone, SFC = spruce-fir forest in the construction zone, SFN = spruce-fir forest outside of the construction zone. All area measures are in hectares.

Event and Date	TRC	TRN	SFC	SFN	All Areas
September 1989	85.19	20.86	88.28	104.81	299.14
LBT Site Expansion 1993	85.19	20.86	100.42	104.81	311.28
After Clark Peak Fire April 1996	51.12	20.85	75.90	104.81	252.68
After Nuttall Fire July 2004	51.12	19.81	58.49	34.14	163.56

Table 2. Mushroom genera known to be food resources of red squirrels, and collected from the food resource plots on the RSMP study areas, Pinaleno Mountains, Arizona.

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 3. Mean filled conifer seed production, on the RSMP study, Pinaleno Mountains, Arizona, 2003. 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	271.92	37.8	394.56	54.8	53.28	7.4
TRN	4	466.50	77.4	126.60	21.0	9.90	1.6
SFC	7	525.60	72.1	1.87	0.3	201.83	27.7
SFN	12	215.43	66.5	12.20	3.8	96.56	29.8
TR Habitat	9	358.40	53.7	275.47	41.2	34.00	5.1
SF Habitat	19	329.71	69.6	8.40	1.8	135.34	28.6

Table 4. Mean annual mushroom production on the RSMP study areas, Pinaleno Mountains, Arizona, 2004.

Area/Habitat	n	\bar{x} Wet weight \pm se (Kg/ha)	\bar{x} Dry weight \pm se (Kg/ha)
TRC	5	7.01 \pm 2.878	0.68 \pm 0.286
TRN	4	30.10 \pm 8.300	2.76 \pm 0.771
SFC	5	14.32 \pm 2.477	1.75 \pm 0.350
SFN	6	1.99 \pm 0.619	0.25 \pm 0.068
TR Habitat	9	17.27 \pm 5.486	1.61 \pm 0.506
SF Habitat	11	7.60 \pm 2.233	0.93 \pm 0.282

Wilcoxon Test within TR:

Wet Weight $Z = 2.327$ **P = 0.020**

Dry Weight $Z = 2.082$ **P = 0.037**

Wilcoxon Test within SF:

Wet Weight $Z = 2.647$ **P = 0.008**

Dry Weight $Z = 2.647$ **P = 0.008**

Table 5. Mean annual mushroom production (wet weight Kg/ha) of selected mushroom genera known to be food resources for red squirrels, 2004. 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>	0.71	10.2	1.79	5.9	0.47	3.3	0.00	0.0
<i>Auricularia</i>	2.83	40.3	6.08	20.2	1.87	13.1	0.00	0.0
<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>	0.00	0.0	0.42	1.4	2.71	18.9	0.37	18.6
<i>Cortinarius</i>	1.37	19.6	9.18	30.5	2.62	18.3	0.19	9.5
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	0.16	0.5	0.00	0.0	0.00	0.0
<i>Leccinum</i>	0.00	0.0	10.17	33.8	0.00	0.0	0.00	0.0
<i>Lycoperdon</i>	0.30	4.3	0.50	1.7	5.13	35.8	0.69	34.8
<i>Pholiota</i>	0.00	0.0	0.26	0.9	0.00	0.0	0.00	0.0
<i>Ramaria</i>	0.00	0.0	0.30	1.0	0.00	0.0	0.00	0.0
<i>Russula</i>	1.79	25.6	1.25	4.1	1.51	10.6	0.74	37.0
<i>Suillus</i>	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Total	7.01		30.10		14.32		1.99	

Table 6. Number and percent of available middens occupied by Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on the RSMP study areas, Pinaleno Mountains, Arizona, 2004.

Area/Habitat	June			December		
	# middens	# occupied	% occ	# middens	# occupied	% occ
TRC	31	8	26	33	12	36
TRN	27	5	19	27	3	11
SFC	28	6	21	21	3	14
SFN	27	9	33	14	0	0
TR Habitat	58	13	22	60	15	25
SF Habitat	55	15	27	35	3	9
TR + SF	113	28	25	95	18	19

Chi Square:

JUNE

within TR $X^2 = 0.441$ df = 1 P = 0.507

within SF $X^2 = 0.982$ df = 1 P = 0.322

DECEMBER

within TR $X^2 = 5.051$ df = 1 **P = 0.025**

Fisher's Exact Test:*

within SF P = 0.259

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

Table 7. Overwinter survival of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on the RSMP study areas, Pinaleno Mountains, Arizona, 2003-2004.

Area/Habitat	Number of	Number of	% survival
	Squirrels	Squirrels Surviving	
	Dec 2003 ¹	Jun 2004	
TRC	11	8	72.7
TRN	6	4	66.7
SFC	8	5	62.5
SFN	11	5	45.5
TR Habitat	17	12	70.6
SF Habitat	19	10	52.6

Fisher Exact Test*

within TR	P = 1.000
within SF	P = 0.650
between habitats	P = 0.322

* Fisher Exact test was used due to the small sample size.

¹ Of the 36 animals resident on the area in Dec 03, 16 were ear-tagged and radio collared thus enabling unique identification and determination of their fate by Jun 04 even if they moved to a different midden or off the area. This large proportion of marked animals in the population increases the accuracy of survival calculations.

Table 8. Mean Local Density of middens and Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on the monitored areas, Pinalaño Mountains, Arizona, 2003 and 2004.

Area/Habitat	December 2003				December 2004			
	Middens		Squirrels ¹		Middens		Squirrels ¹	
	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$
TRC	37	5.6 ± 0.47 ^a	11	1.8 ± 0.30	33	4.7 ± 0.39 ^{ab}	12	1.4 ± 0.29 ^a
TRN	35	5.5 ± 0.30 ^a	6	0.7 ± 0.33 ^{ab}	27	4.3 ± 0.24 ^b	3	0.7 ± 0.33 ^{ab}
SFC	36	2.3 ± 0.19	8	0.6 ± 0.26 ^{ac}	21	1.7 ± 0.29 ^{cd}	3	0.0 ± 0.00 ^b
SFN	32	1.3 ± 0.16	11	0.4 ± 0.15 ^{bc}	14	1.1 ± 0.23 ^d	0	--
TR Habitat	72	5.5 ± 0.28	17	1.4 ± 0.26	60	4.5 ± 0.24	15	1.3 ± 0.25
SF Habitat	68	1.8 ± 0.14	19	0.5 ± 0.14	35	1.5 ± 0.20	3	0.00 ± 0.00
TOTAL ¹	140	3.7 ± 0.22	36	0.9 ± 0.16	95	3.4 ± 0.23	18	1.1 ± 0.24
Kruskal-Wallis LD of Middens								
among all areas		H = 80.32	df=3	P = <0.0001		H = 45.63	df = 2	P < 0.0001
LD of Squirrels								
among all areas		H = 12.52	df=3	P = 0.006		H = 6.25	df = 2	P = 0.044

a,b,c,d 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 9. Mean Nearest Neighbor Distance of middens and Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on the monitored areas, Pinaleño Mountains, Arizona, 2003 and 2004.

Area/Habitat	December 2003				December 2004			
	Middens		Squirrels		Middens		Squirrels	
	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$	n	$\bar{x} \pm se$
TRC	37	42.3 ± 2.86 ^a	11	81.2 ± 12.70 ^{abcd}	33	41.2 ± 2.49 ^a	12	68.9 ± 11.96 ^a
TRN	35	44.3 ± 2.84 ^a	6	107.3 ± 10.10 ^{abcd}	27	50.2 ± 3.07 ^b	3	96.7 ± 5.42 ^{ab}
SFC	36	65.5 ± 5.01 ^b	8	116.0 ± 20.4 ^{abcd}	21	79.0 ± 9.17 ^{cd}	3	311.8 ± 69.49 ^b
SFN	32	83.7 ± 8.58 ^b	11	161.9 ± 36.10 ^{abcd}	14	88.7 ± 18.65 ^d	0	--
TR Habitat	72	43.4 ± 2.00	17	90.4 ± 9.27	60	45.2 ± 2.02	15	74.5 ± 9.98
SF Habitat	68	74.0 ± 4.92	19	142.6 ± 22.7	35	82.9 ± 9.14	3	311.8 ± 69.49
TOTAL ¹	140	58.2 ± 2.90	36	117.9 ± 13.3	95	59.1 ± 4.03	18	114.0 ± 24.96

2003

Kruskal-Wallis:

NND of Middens

among all areas

H = 38.78

df=3

P < 0.0001

H = 24.43

df=2

P < 0.0001

2004

NND of Squirrels

among all areas

H = 4.36

df=3

P = 0.225

H = 8.60

df=2

P = 0.014

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

1 Includes only middens on the monitored areas.

Figure 2a. Corkbark fir (*Abies lasiocarpa* var. *arizonica*) seed fall on the RSMP study areas, Pinaleno Mountains, Arizona, 1993-2003. Note: scales are different for figures 2a-c.

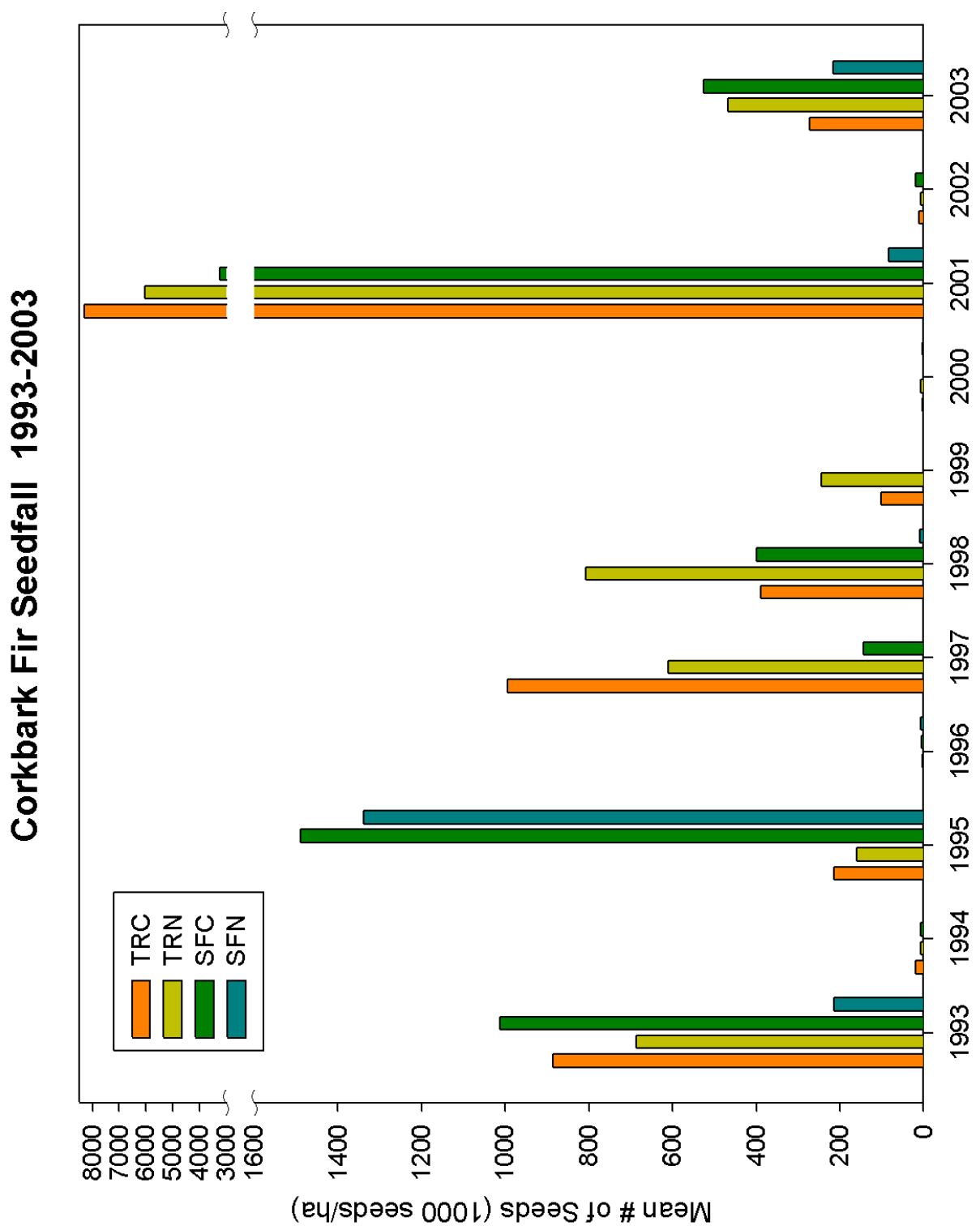


Figure 2b. Douglas-fir (*Pseudotsuga menziesii*) seed fall on the RSMP study areas, Pinaleno Mountains, Arizona, 1993-2003. Note: scales are different for figures 2a-c.

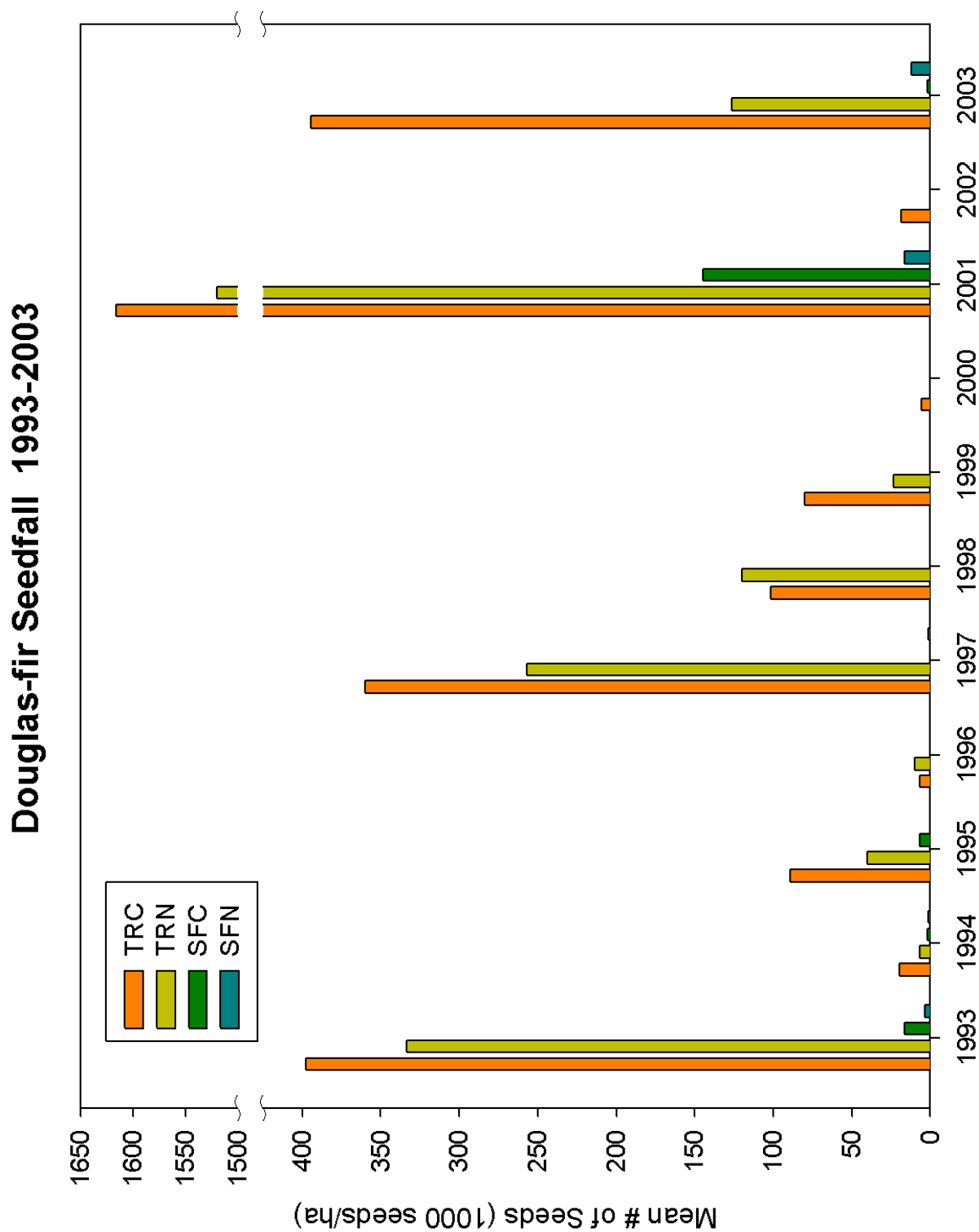


Figure 2c. Engelmann spruce (*Picea engelmannii*) seed fall on the RSMP study areas, Pinaleno Mountains, Arizona, 1993-2003. Note: scales are different for figures 2a-c.

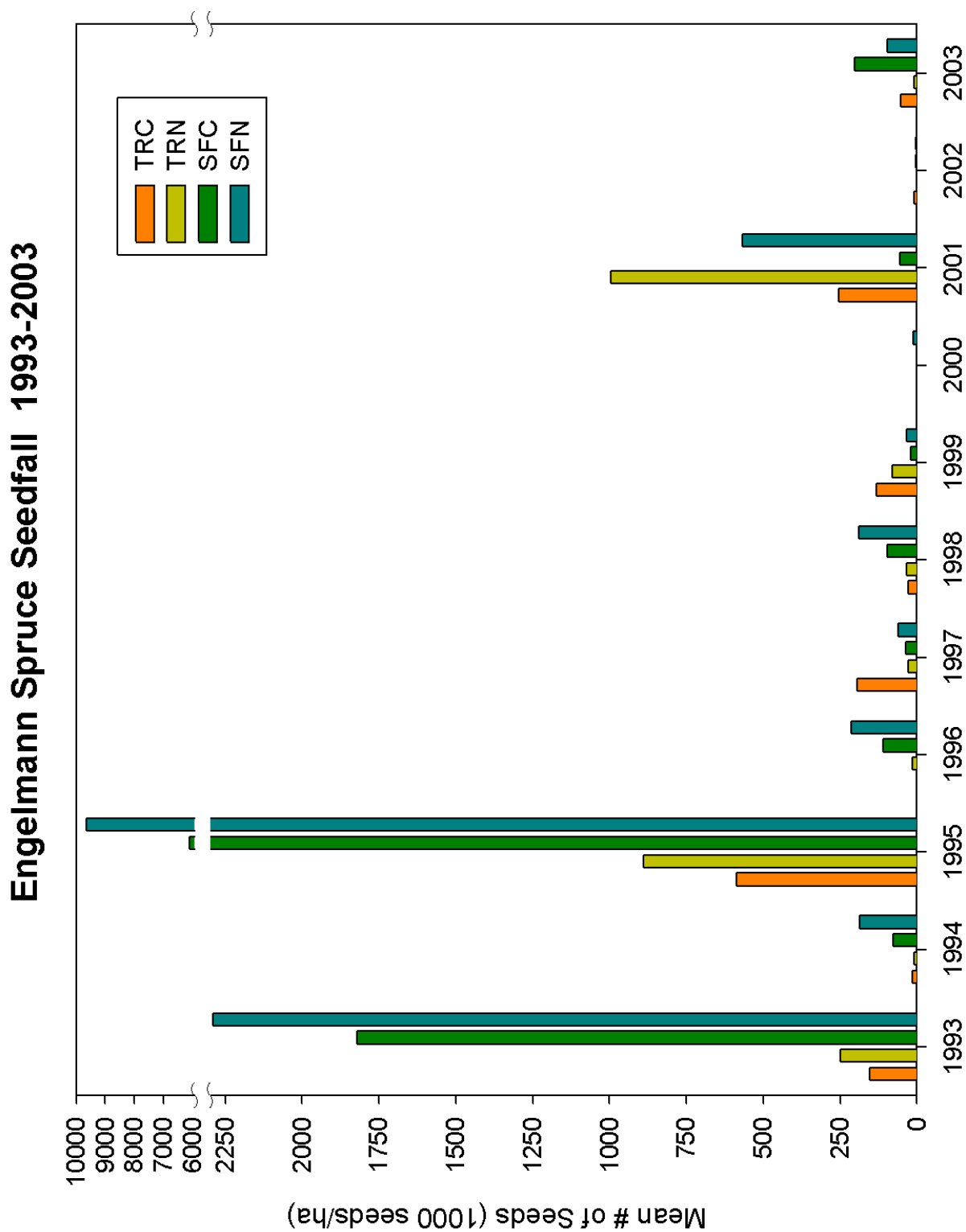


Figure 3. Mushroom crops collected on RSMP study areas, Pinaleno Mountains, Arizona, 1994-2004.

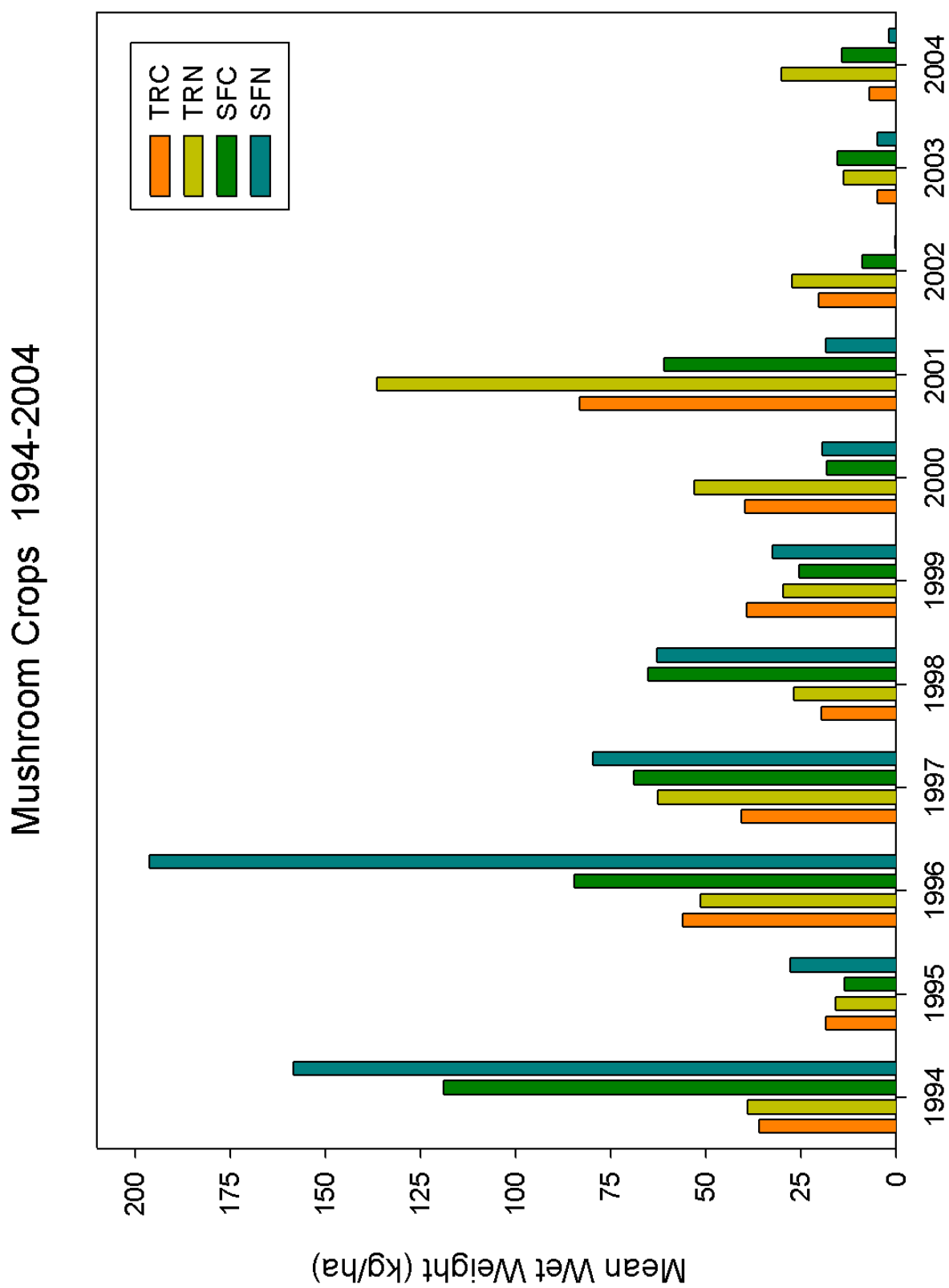


Figure 4. Quarterly Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) populations (including juveniles) on RSMP study areas, Pinaleno Mountains, Arizona, March 2000 - December 2004.

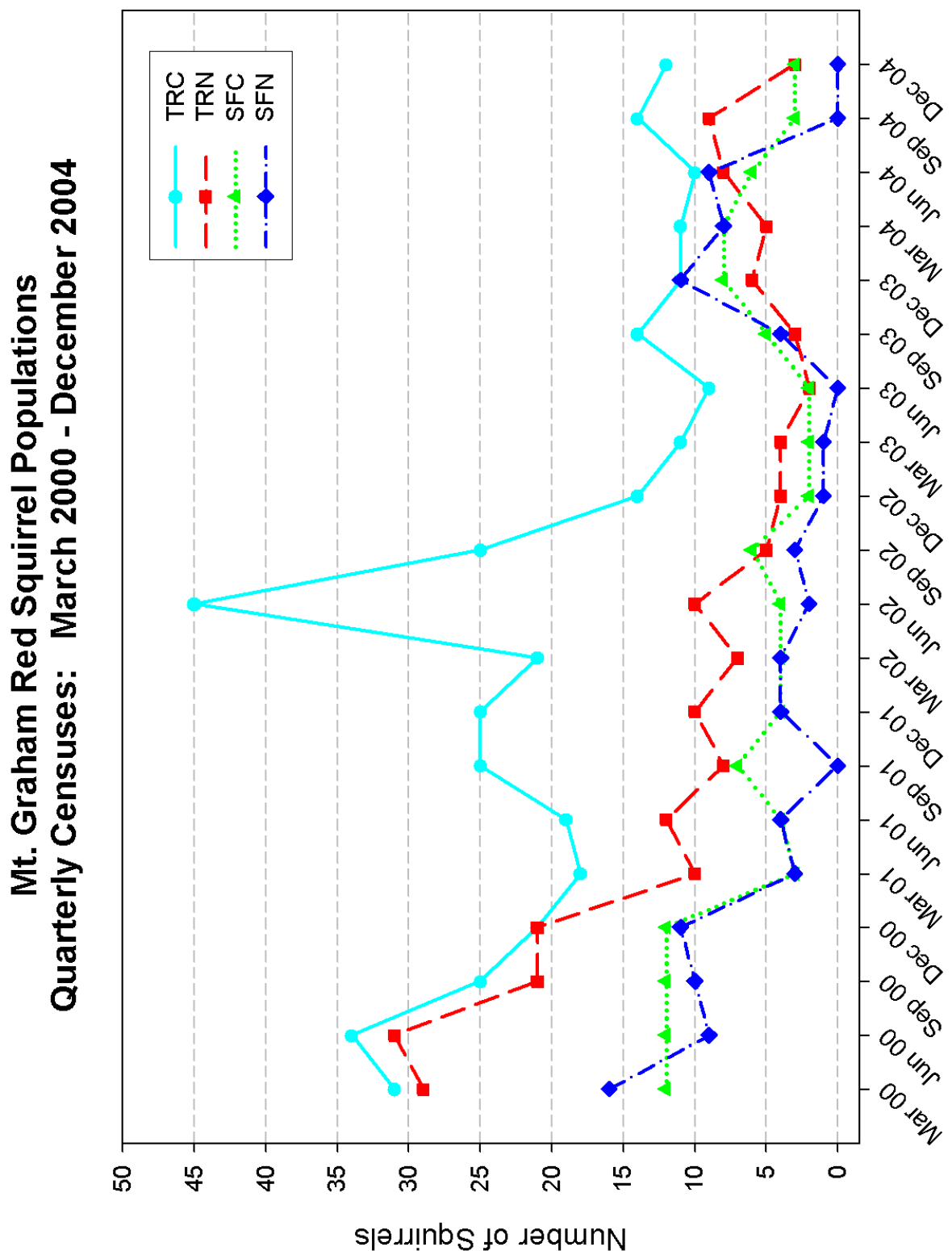
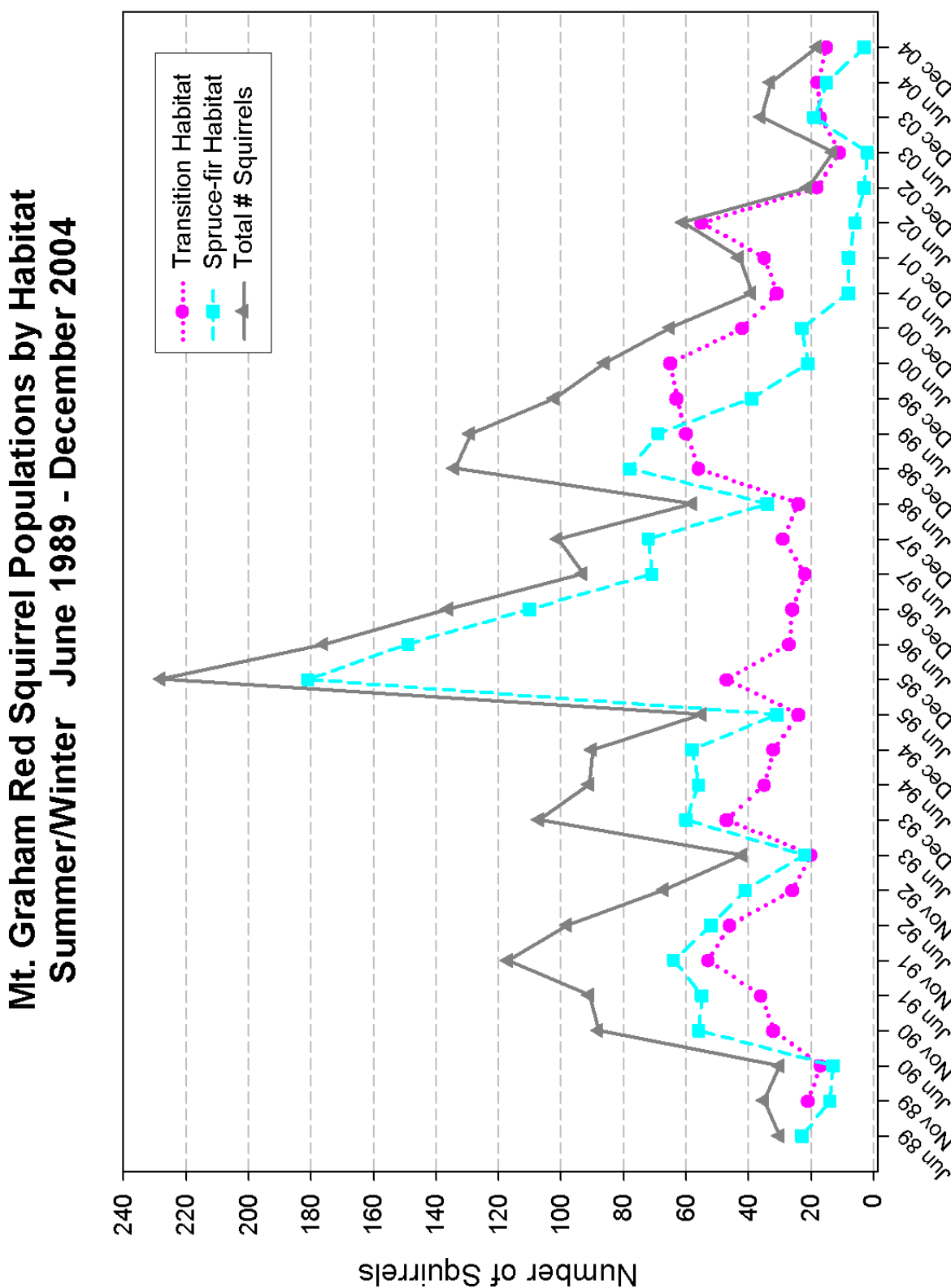


Figure 5. Summer and winter Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) populations (including juveniles) on RSMP study areas, by habitat, June 1989 through December 2004.



Appendix A. Annual conifer seed and mushroom production on RSMP study areas, Pinaleno Mountains, Arizona, 2003.

A-1: By transect

A-2: By area and habitat

Appendix A-1: Annual conifer seed (mean # 1000 filled seeds/ha) and mushroom (mean wet and dry weight - Kg/ha) production on RSMP study areas, Pinaleno Mountains, Arizona, 2003, 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	wet weight Kg/ha	dry weight Kg/ha
TRC	1	burned - Clark Peak Fire, 1996					
	2	burned - Clark Peak Fire, 1996					
	3	266.4	506.4	40.0	812.8	3.64	0.38
	4	burned - Clark Peak Fire, 1996					
	5	560.0	133.2	120.0	813.2	0.15	0.02
	6	burned - Clark Peak Fire, 1996					
	7	burned - Clark Peak Fire, 1996					
	8	burned - Clark Peak Fire, 1996					
	9	burned - Clark Peak Fire, 1996					
	10	133.2	13.2	13.2	159.6	20.33	1.89
	11	40.0	120.0	40.0	200.0	0.17	0.01
	12	360.0	1200.0	53.2	1613.2	0.19	0.02
TRN	1	240.0	120.0	13.2	373.2	2.60	0.25
	2	226.4	280.0	26.4	532.8	15.70	1.51
	3	546.0	93.2	0.0	639.6	10.78	1.10
	4	853.2	13.2	0.0	866.4	25.90	2.45

AREA	TRAN #	Corkbark Fir	Douglas-fir	Englemann Spruce	Total Seeds	Total Mushrooms	
		# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	# 1000 seeds/ha	wet weight Kg/ha	dry weight Kg/ha
SFC	1	986.4	0.0	40.0	1026.4	19.48	2.15
	2	burned - Clark Peak Fire, 1996					
	3	560.0	0.0	13.2	573.2	13.23	1.56
	4	160.0	0.0	0.0	160.0	18.59	2.16
	5	520.0	0.0	0.0	520.0	2.68	0.37
	6	506.4	0.0	920.0	1426.4	34.37	3.66
	7	burned - Clark Peak Fire, 1996					
	8	burned - Clark Peak Fire, 1996					
	9	burned - Clark Peak Fire, 1996					
	10	240.0	0.0	146.4	386.4	7.71	0.70
	11	706.4	13.2	293.2	1012.8	12.00	1.44
SFN	1	213.2	0.0	146.4	359.6	1.17	0.10
	2	93.2	0.0	0.0	93.2	15.23	1.38
	3	533.2	0.0	66.4	599.6	5.00	0.60
	4	146.4	66.4	13.2	226.0	1.89	0.26
	5	13.2	40.0	600.0	653.2	0.00	0.00
	6	13.2	40.0	0.0	53.2	0.00	0.00
	7	253.2	0.0	80.0	333.2	5.14	0.43
	8	240.0	0.0	53.2	293.2	1.11	0.10
	9	200.0	0.0	0.0	200.0	7.21	0.72
	10	613.2	0.0	13.2	626.4	21.08	1.87
	11	26.4	0.0	173.2	199.6	0.00	0.00
	12	240.0	0.0	13.2	253.2	0.00	0.00

Appendix A-2: Annual conifer seed (mean # 1000 filled seeds/ha) and mushroom (mean wet and dry weight - Kg/ha) production on RSMP study areas, Pinaleno Mountains, Arizona, 2003, 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	271.9	394.6	53.5	719.8	4.90	0.46
TRN \bar{x}	4	466.0	126.6	9.9	603.0	13.74	1.33
SFC \bar{x}	7	525.6	1.9	201.8	729.3	15.44	1.71
SFN \bar{x}	12	215.4	12.2	96.6	324.2	4.90	0.46
TR \bar{x}	9	358.4	275.5	34.0	667.9	8.83	0.85
SF \bar{x}	19	329.7	8.4	135.3	473.5	8.73	0.92

Appendix B: Quarterly detailed occupancy records for Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) middens on RSMP study areas, Pinaleño Mountains, Arizona, 2004.

KEY

For Midden Numbers:

###^{89*} Midden Number 'Year Found' '*' following year indicates a newly established midden

For Monthly Occupancy cells:

N	Not Occupied
P	Possibly Occupied, Red Squirrel sign found but unsure of residency
Y	Occupied, Red Squirrel sign indicates resident
S	Occupied, Red Squirrel sighted
♀	Occupied, Adult female Red Squirrel
♂	Occupied, Adult male Red Squirrel
J	Occupied, Juvenile Red Squirrel sex unknown
SA	Occupied, Sub-adult Red Squirrel
A	Abert's Squirrel using area, no Red Squirrel present
XX	Remains of Red Squirrel found
* or ^(R/R)	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), 2004				
Midden	Mar	Jun	Sep	Dec
1101 ⁸⁹	located off-area, new number - 5101			
1102 ⁸⁹	♂ (G/R)	P ³	♂ (m/O RC) ⁷	N ⁷
1103 ⁸⁹	♀ (O/- RC) ²	♀ (O/- RC)	N ²	N
1104 ⁸⁹	N ²	P	N	♀ (O/- RC) ²
1105 ⁸⁹	burned in Clark Peak fire - April 1996			
1106 ⁸⁹	N	N	N	N
1107 ⁸⁹	burned in Clark Peak fire - April 1996			
1108 ⁸⁹	removed from census - low occupancy ¹			
1109 ⁸⁹	burned in Clark Peak fire - April 1996			
1110 ^{89*}	burned in Clark Peak fire - April 1996			
1111 ⁸⁹	N	N	N	N
1112 ^{89*}	N	N	N	N
1113 ⁸⁹	N	N	♀L (R/R RC) + 2J ⁸	N ⁸
1114 ⁸⁹	located off-area, new number - 5114			
1115 ⁸⁹	N	N	N	N
1116 ⁸⁹	♂ (P/G RC)	♂ (rip/G RC)	♂ (rip/G RC)	♂ (rip/G RC)
1117 ⁸⁹	burned in Clark Peak fire - April 1996			
1118 ⁸⁹	♂ (Wsq/Bsq)	♂ (Wsq/m RC)	♂ (Wsq/m RC)	♂ (Wsq/m RC)
1119 ⁸⁸	burned in Clark Peak fire - April 1996			
1120 ⁸⁹	burned in Clark Peak fire - April 1996			
1121 ^{89*}	N	N	N	N
1122 ⁸⁹	burned in Clark Peak fire - April 1996			
1123 ^{95*}	burned in Clark Peak fire - April 1996			
1124 ^{95*}	burned in Clark Peak fire - April 1996			
1125 ^{95*}	burned in Clark Peak fire - April 1996			
1126 ^{95*}	removed from census - low occupancy ¹			
1130 ⁹⁰	burned in Clark Peak fire - April 1996			
1131 ^{90*}	♀ (Rsq/Gsq)	♀L (Rsq/Gsq RC) ⁶ + 2J	♂	♂ (Gsq/Ysq RC)
1132 ^{90*}	removed from census - low occupancy ¹			
1134 ^{91*}	removed from census - low occupancy ¹			
1135 ^{91*}	burned in Clark Peak fire - April 1996			
1136 ^{91*}	burned in Clark Peak fire - April 1996			

Transition Construction Area (TRC), 2004				
Midden	Mar	Jun	Sep	Dec
1137 ^{91*}	burned in Clark Peak fire - April 1996			
1138 ^{91*}	removed from census - low occupancy ¹			
1139 ^{91*}	burned in Clark Peak fire - April 1996			
1140 ^{91*}	burned in Clark Peak fire - April 1996			
1142 ^{91*}	burned in Clark Peak fire - April 1996			
1143 ^{91*}	burned in Clark Peak fire - April 1996			
1144 ^{91*}	♀ (P/W RC)	♂ ⁴	♂ (Gsq/Wsq RC)	♂ (Gsq/Wsq RC)
1145 ^{91*}	located off-area, new number - 5145			
1146 ^{91*}	removed from census - low occupancy ¹			
1147 ^{91*}	♂	P	N	N
1148 ^{91*}	burned in Clark Peak fire - April 1996			
1149 ^{91*}	N	N	N	N
1150 ^{91*}	located off-area, new number - 5150			
1151 ^{91*}	N	N	N	N
1152 ^{91*}	burned in Clark Peak fire - April 1996			
1153 ^{92*}	♂ (O/G RC)	♂ (-/G RC) ⁵	N ⁵	N
1154 ^{92*}	N	N	♀	N
1155 ^{93*}	located off-area, new number - 5155			
1156 ^{93*}	♀ (R/R)	♀ (R/R RC)	♂ (P/W RC)	♀ (R/R RC) ⁸
1157 ^{93*}	located off-area, new number - 5157			
1159 ^{93*}	burned in Clark Peak fire - April 1996			
1160 ^{96*}	N	N	♂ (-/G RC) ⁵	♂ (Ysq/Wsq)
1161 ^{96*}	removed from census - low occupancy ¹			
1162 ^{96*}	♀	N	♂ (m/G RC)	♂ (m/G RC)
1163 ^{98*}	N	N	♀ (Rsq/Gsq RC) ⁶	♀ (Rsq/Gsq RC)
1164 ^{98*}	removed from census - low occupancy ¹			
1165 ^{98*}	removed from census - low occupancy ¹			
1166 ^{98*}	removed from census - low occupancy ¹			
1167 ^{98*}	N	N	N	N
1168 ^{98*}	N	N	N	N
1169 ^{98*}	removed from census - low occupancy ¹			
1170 ^{98*}	♂ (W/m RC)	♂ (W/m RC)	♂ (W/m RC)	♂ (W/m RC)

Transition Construction Area (TRC), 2004				
Midden	Mar	Jun	Sep	Dec
1171 ^{98*}	N	N	N	N
1172 ^{90*}	removed from census - low occupancy ¹			
1173 ^{99*}	N	N	N	N
1174 ^{99*}	removed from census - low occupancy ¹			
1175 ^{99*}	removed from census - low occupancy ¹			
1176 ^{99*}	removed from census - low occupancy ¹			
1177 ^{99*}	N	N	N	N
1178 ^{99*}	removed from census - low occupancy ¹			
1179 ^{99*}	N	N	N	N
1180 ^{99*}	N	N	N	N
1181 ^{99*}	removed from census - low occupancy ¹			
1182 ^{02*}	N	N	N	N
1183 ^{04*}	New Midden Dec 04			♀ (m/m) ¹⁰
1184 ^{04*}	New Midden Dec 04			♂ (m/ORC) ¹¹
# Mid	31	31	31	33
# Occ	11	8	12	12
% Occ	36	26	39	36
# Sq	11	8 + 2J	12 + 2J	12

Appendix B - 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. After 2003, all of the removed-low occupancy middens are checked each census. Any middens that become reoccupied are added back to regular censusing.
- 2 Based on feeding sign, and telemetry and night nest data, it appears that ♀ O/- RC has changed her residency from midden 1104 to midden 1103 between the December 2003 and March 2004 censuses. She had resided at midden 1103 in the past. By September, this female had shifted residency to midden 2242 (see notes for that midden). By December, this female appeared to have moved back up the drainage to midden 1104.
- 3 Several different individuals were seen spending time at midden 1102 during the June census (♂ -/G, ♀ O/rip, ♀ G/B, ♂ R/Y, ♂ m/rip), but none were clearly the resident. The resident of 1102 in March (♂ G/R) was located to the west of the study area at AGFD midden 8025.
- 4 On 15 Apr 04 the radio collar of ♀ P/W, resident of midden 1144, was found along with clumps of fur at the base of a nest about 50 m southwest of the midden. By June an unmarked male was resident at this midden.
- 5 The resident of midden 1153, ♂ (O/G RC), has lost the colored ear tag from his left ear and is now ♂ (-/G RC). Sometime after the June 2004 census, this male moved south on the study area, first to midden 1177 then to midden 1160 where he was resident in September. The radio collar for this male was found near midden 1131 on 21 Sep 04, but no signs of predation were found, so his fate is undetermined. Therefore, he will be counted as resident for the month of September.
- 6 The female resident from midden 1131 (R/G RC) was located in a maternity nest near 1164 on 27 Jun 04, 1 small juvenile was seen on 28 Jun 04, and 2 juveniles were confirmed on 2 Jul 04. By September, this female had shifted residency to midden 1163.
- 7 The male at midden 1102 in September 2004 was a former resident of midden 5101. He appeared to shift residency towards 1102 sometime in July, and a new resident (♂ Bsq/Ysq RC) was in midden 5101. By December, ♂ (m/O RC) had established a new midden up the hill from 1102.
- 8 This female was the former resident of midden 1156, but began to shift activity near midden 1113 in July/August. A maternity nest was located nearby and 3 juveniles were confirmed on 20 Aug 04. However, only two were confirmed during the Sep census and were counted in the population totals. By December, ♀ (R/R RC) had shifted her residence back to midden 1156.
- 9 The ♂ (P/W RC), resident at 1156, was last seen in late September. His signal was not detected on or near the study areas, and his fate remains unknown. About the same time (late Sep), the former resident ♀ (R/R RC), shifted her activities back around midden 1156 (see footnote 8 also).

Appendix B - TRC (cont.)

- 10 A new midden on the TRC area, that had some activity since late September. In December there was continued activity and a resident squirrel, ♀SA (m/m), so the midden was numbered and officially added to the census. The female was tagged as a juvenile on the study area, but her identity is unknown as of Dec 04. Future trapping efforts will allow proper ID of the ear tags.
- 11 Male (m/O RC), resident at midden 1102 in September, began to shift his activities in late Sep/early Oct 04 to an area about 75m S of midden 1102. In December there was continued activity and presence of ♂ (m/O RC), so the midden was numbered and officially added to the census.

Transition Non-Construction Area (TRN), 2004				
Midden	Mar	Jun	Sep	Dec
2201 ⁸⁹	removed from census - low occupancy ¹			
2202 ⁸⁹	N	N	N	N
2203 ⁸⁹	N	N	N	N
2204 ⁸⁹	N	N	N	N
2205 ⁸⁹	N	N	N	N
2206 ⁸⁹	N	N	N	N
2207 ^{89*}	burned in Nuttall fire - July 2004			
2208 ^{89*}	N	N	N	N
2209 ⁸⁹	removed from census - low occupancy ¹			
2210 ⁹⁰	N	♀L (G/B RC) ² +3J	N ²	N
2211 ^{90*}	♀ (G/B RC)	♂ (Osq/Bsq RC) ²	♂ (rip/m RC) ²	♂ (Bsq/Bsq RC) ²
2212 ⁹⁰	removed from census - low occupancy ¹			
2213 ⁹⁰	removed from census - low occupancy ¹			
2214 ^{90*}	located on TRC, new number - 1172			
2215 ^{90*}	♂ (R/Y RC)	♂ (R/Y RC)	♂ (R/Y RC)	♂ (R/m RC) ⁶
2216 ^{90*}	♂ (G/G)	P ³	♀ (G/B RC) ³	♀ (G/B RC)
2217 ^{90*}	N	N	N	N
2218 ^{91*}	N	N	N	N
2219 ^{91*}	removed from census - low occupancy ¹			
2220 ^{91*}	removed from census - low occupancy ¹			
2221 ^{91*}	located off-area, new number - 5221			
2222 ^{91*}	removed from census - low occupancy ¹			
2223 ^{91*}	N	N	N	N
2224 ^{93*}	removed from census - low occupancy ¹			
2225 ⁹⁴	removed from census - low occupancy ¹			
2226 ^{95*}	removed from census - low occupancy ¹			
2227 ^{95*}	N	N	N	N
2228 ^{95*}	removed from census - low occupancy ¹			
2229 ^{96*}	♂	♂	P	N
2230 ^{96*}	N	N	N	N
2231 ^{96*}	located off-area, new number - 5231			

Transition Non-Construction Area (TRN), 2004				
Midden	Mar	Jun	Sep	Dec
2232 ^{96*}	located off-area, new number - 5232			
2233 ^{96*}	removed from census - low occupancy ¹			
2234 ^{97*}	N	N	P	N
2235 ^{98*}	N	N	N	N
2236 ^{98*}	N	N	N	N
2237 ^{98*}	N	N	N	N
2238 ⁹⁸	removed from census - low occupancy ¹			
2239 ⁹⁸	removed from census - low occupancy ¹			
2240 ⁹⁸	removed from census - low occupancy ¹			
2241 ^{98*}	N	N	N	N
2242 ^{98*}	♂ [♂] (O/W)	♂ [♂] 4	♀L (O/rip RC) + 5J ⁵	N ⁵
2243 ⁹⁸	removed from census - low occupancy ¹			
2244 ^{99*}	N	N	N	N
2245 ^{99*}	removed from census - low occupancy ¹			
2246 ^{99*}	N	N	N	N
2247 ^{99*}	burned in Nuttall fire - July 2004			
2248 ^{99*}	N	N	N	N
2249 ^{99*}	N	N	N	N
2250 ^{00*}	N	N	N	N
2251 ^{00*}	removed from census - low occupancy ¹			
# Mid	27	27	27	27
# Occ	5	5	4	3
% Occ	19	19	15	11
# Sq	5	5 + 3J	4 + 5J	3

Appendix B - 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. After 2003, all of the removed-low occupancy middens are checked each census. Any middens that become reoccupied are added back to regular censusing.
- 2 The former resident of midden 2211, ♀ B/G RC, spent much of the month of June ranging around the northern part of the TR areas. She had a maternity nest near midden 2210, and 3 juveniles were confirmed on 27 Jun 04. By the end of the month, the ♂ (Osq/Bsq RC) seemed to be the new resident of midden 2211, with several night nests in the area. By September this male had lost both his ear tags (rip/metal RC). In October, this animal's tags were replaced and his new colors are (Bsq/Bsq RC).
- 3 The resident of midden 2216 in March, ♂ (G/G), was not seen during several observations in June. Neighboring squirrels ♂ (R/Y RC 2215) and ♀ (G/B RC 2210) were both seen several times taking food from this midden. It did not appear that there was a permanent resident. By September, ♀ (G/B RC 2210/2211) was resident at midden 2216 and nearby shift.
- 4 The resident ♂ of midden 2242 in June appears to be a different animal than in March, i.e. no signs of previous tags.
- 5 Female (O/rip RC), former resident of midden 1103 (see notes for that midden also) was resident at midden 2242 and a nearby maternity nest, where 5 juveniles were confirmed on 3 Sep 04. This was the second reproductive effort for this female in 2004. She was noted to be pregnant in May, but no juveniles were ever detected. By December, this female had moved back up the drainage to midden 1104.
- 6 The male at midden 2215, by December had lost an ear tag and is now (R/m RC).

Spruce-Fir Construction Area (SFC), 2004				
Midden	Mar	Jun	Sep	Dec
3000 ^{95*}	burned in Nuttall fire - July 2004			
3001 ^{95*}	burned in Nuttall fire - July 2004			
3002 ^{95*}	removed from census - low occupancy ¹			
3003 ^{95*}	removed from census - low occupancy ¹			
3004 ^{95*}	burned in Clark Peak fire - April 1996			
3005 ^{95*}	removed from census - low occupancy ¹			
3006 ^{95*}	destroyed by fire suppression in Nuttall fire - July 2004			
3007 ^{95*}	removed from census - too far off area, new # 5307			
3008 ^{95*}	N	N	burned in Nuttall fire - July 2004	
3009 ^{95*}	removed from census - low occupancy ¹			
3010 ^{95*}	removed from census - low occupancy ¹			
3011 ^{95*}	located off-area, new number - 5311			
3012 ^{95*}	burned in Clark Peak fire - April 1996			
3013 ^{95*}	removed from census - low occupancy ¹			
3014 ^{95*}	removed from census - low occupancy ¹			
3015 ^{95*}	burned in Clark Peak fire - April 1996			
3016 ^{95*}	burned in Clark Peak fire - April 1996			
3017 ^{95*}	burned in Clark Peak fire - April 1996			
3018 ^{95*}	burned in Clark Peak fire - April 1996			
3019 ^{96*}	removed from census - low occupancy ¹			
3020 ^{96*}	N	N	N	N
3021 ^{96*}	burned in Clark Peak fire - April 1996			
3022 ^{96*}	removed from census - low occupancy ¹			
3023 ^{96*}	burned in Nuttall fire - July 2004			
3024 ^{98*}	removed from census - low occupancy ¹			
3025 ^{98*}	removed from census - low occupancy ¹			
3026 ^{98*}	removed from census - low occupancy ¹			
3027 ^{99*}	removed from census - low occupancy ¹			
3028 ^{99*}	N	N	N	N
3029 ^{99*}	removed from census - low occupancy ¹			
3030 ^{99*}	removed from census - low occupancy ¹			
3031 ^{99*}	removed from census - low occupancy ¹			
3032 ^{99*}	removed from census - low occupancy ¹			

Spruce-Fir Construction Area (SFC), 2004				
Midden	Mar	Jun	Sep	Dec
3300 ⁸⁶	burned in Nuttall fire - July 2004			
3301 ^{94*}	Y ²	P	burned in Nuttall fire - July 2004	
3302 ^{94*}	located off-area, new number - 5302			
3303 ^{94*}	N	N	N	N
3304 ^{94*}	removed from census - low occupancy ¹			
3305 ^{94*}	removed from census - low occupancy ¹			
3306 ^{94*}	burned in Nuttall fire - July 2004			
3307 ^{94*}	removed from census - low occupancy ¹			
3308 ^{95*}	burned in Nuttall fire - July 2004			
3309 ^{95*}	removed from census - low occupancy ¹			
3310 ^{95*}	removed from census - low occupancy ¹			
3311 ^{95*}	N	N	N	N
3312 ^{95*}	N	N	N	N
3313 ^{95*}	located off-area, new number - 5313			
3314 ^{95*}	N	N	N	N
3315 ^{95*}	removed from census - low occupancy ¹			
3316 ^{95*}	burned in Nuttall fire - July 2004			
3317 ^{95*}	removed from census - low occupancy ¹			
3318 ^{95*}	removed from census - low occupancy ¹			
3319 ^{95*}	removed from census - low occupancy ¹			
3320 ^{95*}	removed from census - low occupancy ¹			
3321 ^{95*}	burned in Nuttall fire - July 2004			
3322 ^{95*}	removed from census - low occupancy ¹			
3323 ^{95*}	P	P	N	N
3324 ^{95*}	removed from census - low occupancy ¹			
3325 ^{95*}	removed from census - low occupancy ¹			
3326 ^{95*}	removed from census - low occupancy ¹			
3327 ^{95*}	removed from census - low occupancy ¹			
3328 ^{95*}	removed from census - low occupancy ¹			
3329 ^{95*}	removed from census - low occupancy ¹			
3330 ^{95*}	N	N	N	N
3331 ^{95*}	♀ ³	♀	burned in Nuttall fire - July 2004 ³	
3332 ^{95*}	removed from census - low occupancy ¹			

Spruce-Fir Construction Area (SFC), 2004				
Midden	Mar	Jun	Sep	Dec
3333 ^{95*}	removed from census - low occupancy ¹			
3334 ^{95*}	burned in Nuttall fire - July 2004			
3335 ^{95*}	removed from census - low occupancy ¹			
3336 ^{95*}	removed from census - low occupancy ¹			
3337 ^{95*}	removed from census - low occupancy ¹			
3338 ^{95*}	burned in Nuttall fire - July 2004			
3339 ^{95*}	removed from census - low occupancy ¹			
3340 ^{95*}	removed from census - low occupancy ¹			
3341 ^{95*}	N	N	N	N
3342 ^{95*}	removed from census - low occupancy ¹			
3343 ^{95*}	removed from census - low occupancy ¹			
3344 ^{95*}	removed from census - low occupancy ¹			
3345 ^{95*}	removed from census - low occupancy ¹			
3346 ^{95*}	removed from census - low occupancy ¹			
3347 ^{95*}	removed from census - low occupancy ¹			
3348 ^{95*}	♂ ^(O/O)	P ⁶	N	N
3349 ^{95*}	burned in Nuttall fire - July 2004			
3350 ⁸⁷	removed from census - low occupancy ¹			
3351 ⁸⁷	burned in Nuttall fire - July 2004			
3352 ⁸⁶	removed from census - low occupancy ¹			
3353 ⁸⁷	removed from census - low occupancy ¹			
3354 ⁸⁶	removed from census - low occupancy ¹			
3355 ^{95*}	burned in Nuttall fire - July 2004			
3356 ⁸⁶	N	N	burned in Nuttall fire - July 2004	
3357 ⁸⁶	removed from census - low occupancy ¹			
3358 ⁸⁷	burned in Clark Peak fire - April 1996			
3359 ⁸⁷	burned in Clark Peak fire - April 1996			
3360 ⁸⁶	♂ ^{(Ysq/Ysq) 4}	♂ ^(Ysq/Ysq RC)	♂ ^(Ysq/Ysq RC)	♂ ^(Ysq/Ysq RC)
3361 ⁸⁶	removed from census - low occupancy ¹			
3362 ⁸⁶	N	N	N	N
3363 ⁸⁶	removed from census - low occupancy ¹			
3364 ⁸⁶	removed from census - low occupancy ¹			
3365 ⁸⁶	♂ ^{(Wsq/Wsq RC) 5}	♂ ^(Wsq/Wsq RC)	♂ ^{(Wsq/Wsq RC) 8}	♀ ^{(Wsq/Ysq RC) 8}

Spruce-Fir Construction Area (SFC), 2004				
Midden	Mar	Jun	Sep	Dec
3366 ⁸⁶	♀ (Ysq/Psq)	♀ L (Ysq/Psq RC)	P ⁹	N
3367 ⁸⁷	removed from census - low occupancy ¹			
3368 ⁸⁶	removed from census - low occupancy ¹			
3369 ⁸⁶	removed from census - low occupancy ¹			
3370 ⁸⁶	N	N	N	N
3371 ⁸⁷	N	N	N	N
3372 ⁸⁹	N	N	N	N
3373 ⁸⁷	removed from census - low occupancy ¹			
3374 ⁸⁹	N	N	♀	♂
3375 ⁸⁶	removed from census - low occupancy ¹			
3376 ⁸⁶	located off-area, new number - 5376			
3377 ⁸⁷	located off-area, new number - 5377			
3378 ^{90*}	♀ (O/R RC)	♀ (O/R RC) 7	N	N
3379 ^{90*}	removed from census - low occupancy ¹			
3380 ^{90*}	removed from census - low occupancy ¹			
3381 ⁹⁰	N	N	burned in Nuttall fire - July 2004	
3382 ^{91*}	N	N	N	N
3383 ^{91*}	removed from census - low occupancy ¹			
3384 ^{91*}	burned in Clark Peak fire - April 1996			
3385 ^{91*}	removed from census - low occupancy ¹			
3386 ^{91*}	removed from census - low occupancy ¹			
3387 ^{91*}	N	N	burned in Nuttall fire - July 2004	
3388 ^{92*}	located off-area, new number - 5388			
3389 ^{93*}	removed from census - low occupancy ¹			
3390 ^{93*}	removed from census - low occupancy ¹			
3390 ^{93*}	removed from census - low occupancy ¹			
3391 ^{93*}	removed from census - low occupancy ¹			
3392 ^{93*}	removed from census - low occupancy ¹			
3393 ^{93*}	destroyed by fire suppression in Nuttall fire - July 2004			
3394 ^{93*}	N	N	N	N
3395 ^{94*}	removed from census - low occupancy ¹			
3396 ^{94*}	removed from census - low occupancy ¹			
3397 ⁸⁶	♂ (Ysq/Gsq)	♂ (Ysq/Gsq RC) 10	burned in Nuttall fire - July 2004	

Spruce-Fir Construction Area (SFC), 2004				
Midden	Mar	Jun	Sep	Dec
3398 ⁸⁶	burned in Nuttall fire - July 2004			
3399 ^{94*}	burned in Nuttall fire - July 2004			
# Mid	28	28	21	21
# Occ	8	6	3	3
% Occ	28	21	14	14
# Sq	8	6	3	3

Appendix B - 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. After 2003, all of the removed-low occupancy middens are checked each census. Any middens that become reoccupied are added back to regular censusing.
- 2 Midden 3301 was listed as occupied for the March census based on feed sign only. An unmarked squirrel was seen several times in the general area, and may have been associated with midden 3301 as there were no signs at nearby middens. However, further observations at midden 3301 could not confirm this.
- 3 Marked ♂ Psq/Psq was seen entering midden 3331 several times and was chased off by the resident ♀. The residency of ♂ Psq/Psq is unknown for March (see also notes for 5311). Midden 3331 was severely burned in the Nuttall Fire in Jul 2004. The unmarked female resident in Jun 2004 was not seen after the fire and her fate is unknown.
- 4 The female resident (G/P) of midden 3360 was not observed in that midden after December. (see also notes for midden 5311). An adult male was caught and radio collared (Ysq/Ysq RC) and mid-January at 3360 where he has remained.
- 5 Male Wsq/Wsq RC appeared to be the new resident of midden 3365 by the end of March 2004. The fate of the previous resident, ♀ P/R RC, remained undetermined by the end of March 2004. Her radio signal has not appeared to move from a location under the snow at the base of a tree approximately 30 meters north of midden 3019. Several observations were made at this location during the month, but no visual confirmation was made.
- 6 The male (O/O RC) resident of 3348, appeared to be shifting his activities more towards nearby midden 5350. However, the ♂ was still seen in the vicinity of midden 3348 shift during the June census. See also notes for midden 5350.
- 7 ♀ (O/R RC), resident of midden 3378, spent quite a bit of time away from her midden in June. She established a new nest approximately 150 m southeast of midden 3378. She was also seen in middens 3360 and 5350. Her radio collar failed, so it was unknown if she established residency at a new midden. She wasn't seen after early June.
- 8 There was some fire suppression damage from the Nuttall fire in the area around (but not directly in) midden 3365. The ♂ (Wsq/Wsq RC) resident in Sep was last seen in early Nov. Thereafter, only his radio signal was detected out of the same nest 13125. On 10 Dec 04, an unmarked animal was seen feeding in midden 3365 and a female squirrel (Wsq/Ysq RC) was trapped and marked on 13 Dec 04. This female was observed to be using nest 13125 and telemetry data for the month of December confirmed her occupancy at midden 3365.

Appendix B - SFC (cont.)

- 9 Female (Ysq/Psq RC) was resident at midden 3366 in June, before the Nuttall fire. There was no direct damage to the midden but a dozer line was about 15m E. The female was located after the fire in late July, in the area N of midden 3366. She was located in a maternity nest 13141, NE of midden 3019. Three juveniles were observed at this nest on 9 Aug 04. By 19 Aug, this female had moved her litter to a new nest, 15318, N of midden 5377. On 30 Aug, 1 large juvenile was seen following the female into nest 15306 near midden 5353. By September, female (Ysq/Psq RC) had established residency at midden CO-58/8736 located about 250m N of the SFC area.
- 10 The male (Ysq/Gsq RC), resident of midden 3397 in June, was not located following the Nuttall fire. The midden was destroyed by fire, and the fate of this male is unknown.

Spruce-Fir Non Construction Area (SFN), 2004				
Midden	Mar	Jun	Sep	Dec
4000 ^{95*}		N	N	N
4001 ^{95*}	burned in Nuttall fire - July 2004			
4002 ^{95*}	removed from census - low occupancy ¹			
4003 ^{95*}	burned in Nuttall fire - July 2004			
4004 ^{95*}	burned in Nuttall fire - July 2004			
4005 ^{95*}	burned in Nuttall fire - July 2004			
4006 ^{95*}	burned in Nuttall fire - July 2004			
4007 ^{95*}	burned in Nuttall fire - July 2004			
4008 ^{95*}	♀	♂	burned in Nuttall fire - July 2004 ⁴	
4009 ^{95*}	burned in Nuttall fire - July 2004			
4010 ^{95*}	N	N	N	N
4011 ^{95*}	removed from census - low occupancy ¹			
4012 ^{95*}	burned in Nuttall fire - July 2004			
4013 ^{96*}	removed from census - low occupancy ¹			
4014 ^{96*}	removed from census - low occupancy ¹			
4015 ^{96*}	N	N	burned in Nuttall fire - July 2004	
4016 ^{96*}	N	N	N	N
4017 ^{96*}	burned in Nuttall fire - July 2004			
4018 ^{96*}	burned in Nuttall fire - July 2004			
4019 ^{96*}	burned in Nuttall fire - July 2004			
4020 ^{96*}	removed from census - low occupancy ¹			
4021 ^{96*}	burned in Nuttall fire - July 2004			
4022 ^{98*}	removed from census - low occupancy ¹			
4023 ^{98*}	removed from census - low occupancy ¹			
4024 ^{98*}	removed from census - low occupancy ¹			
4025 ^{99*}	removed from census - low occupancy ¹			
4400 ⁸⁹	N	N	N	N
4401 ^{94*}	burned in Nuttall fire - July 2004			
4402 ^{94*}	burned in Nuttall fire - July 2004			
4403 ^{94*}	removed from census - low occupancy ¹			
4404 ^{95*}	P ²	N	burned in Nuttall fire - July 2004	
4405 ^{95*}	burned in Nuttall fire - July 2004			
4406 ^{95*}	burned in Nuttall fire - July 2004			

Spruce-Fir Non Construction Area (SFN), 2004				
Midden	Mar	Jun	Sep	Dec
4407 ^{95*}	burned in Nuttall fire - July 2004			
4408 ^{95*}	removed from census - low occupancy ¹			
4409 ^{95*}	burned in Nuttall fire - July 2004			
4410 ^{95*}	located off-area, new number - 5410			
4411 ^{95*}	burned in Nuttall fire - July 2004			
4412 ^{95*}	burned in Nuttall fire - July 2004			
4413 ^{95*}	located off-area, new number - 5413			
4414 ^{95*}	burned in Nuttall fire - July 2004			
4415 ^{95*}	burned in Nuttall fire - July 2004			
4416 ^{95*}	burned in Nuttall fire - July 2004			
4417 ^{95*}	N	N	N	N
4418 ^{95*}	burned in Nuttall fire - July 2004			
4419 ^{95*}	N	♂	burned in Nuttall fire - July 2004 ⁵	
4420 ⁹⁰	N	N	burned in Nuttall fire - July 2004	
4421 ⁸⁶	burned in Nuttall fire - July 2004			
4422 ⁸⁶	S	♂	burned in Nuttall fire - July 2004 ⁶	
4423 ⁸⁶	burned in Nuttall fire - July 2004			
4424 ⁸⁶	burned in Nuttall fire - July 2004			
4425 ⁸⁷	burned in Nuttall fire - July 2004			
4426 ⁸⁶	burned in Nuttall fire - July 2004			
4427 ⁸⁶	S	♀L	burned in Nuttall fire - July 2004 ⁷	
4428 ⁸⁶	burned in Nuttall fire - July 2004			
4429 ⁸⁶	N	N	burned in Nuttall fire - July 2004	
4430 ⁸⁶	burned in Nuttall fire - July 2004			
4431 ⁸⁶	burned in Nuttall fire - July 2004			
4432 ⁸⁶	burned in Nuttall fire - July 2004			
4433 ⁸⁷	burned in Nuttall fire - July 2004			
4434 ⁸⁶	burned in Nuttall fire - July 2004			
4435 ⁸⁶	♂	♂	burned in Nuttall fire - July 2004 ⁴	
4436 ⁸⁶	burned in Nuttall fire - July 2004			
4437 ^{95*}	burned in Nuttall fire - July 2004			
4438 ^{90*}	burned in Nuttall fire - July 2004			
4439 ^{90*}	burned in Nuttall fire - July 2004			
4440 ⁹¹	burned in Nuttall fire - July 2004			

Spruce-Fir Non Construction Area (SFN), 2004				
Midden	Mar	Jun	Sep	Dec
4441 ⁸⁶	burned in Nuttall fire - July 2004			
4442 ^{95*}	burned in Nuttall fire - July 2004			
4443 ⁸⁶	burned in Nuttall fire - July 2004			
4444 ⁸⁶	burned in Nuttall fire - July 2004			
4445 ⁸⁶	burned in Nuttall fire - July 2004			
4446 ⁸⁶	burned in Nuttall fire - July 2004			
4447 ⁸⁶	burned in Nuttall fire - July 2004			
4448 ⁸⁶	burned in Nuttall fire - July 2004			
4449 ⁸⁶	♂	♂	burned in Nuttall fire - July 2004 ⁸	
4450 ⁸⁶	burned in Nuttall fire - July 2004			
4451 ⁸⁸	burned in Nuttall fire - July 2004			
4452 ⁸⁶	burned in Nuttall fire - July 2004			
4453 ⁸⁶	burned in Nuttall fire - July 2004			
4454 ⁸⁶	removed from census - low occupancy ¹			
4455 ⁸⁶	burned in Nuttall fire - July 2004			
4456 ⁸⁶	burned in Nuttall fire - July 2004			
4457 ⁸⁶	burned in Nuttall fire - July 2004			
4458 ⁸⁶	removed from census - low occupancy ¹			
4459 ⁸⁶	burned in Nuttall fire - July 2004			
4460 ⁸⁷	N	N	burned in Nuttall fire - July 2004	
4461 ^{91*}	P ²	N	burned in Nuttall fire - July 2004	
4462 ⁹⁰	burned in Nuttall fire - July 2004			
4463 ⁹⁰	burned in Nuttall fire - July 2004			
4464 ⁹⁰	removed from census - low occupancy ¹			
4465 ^{90*}	removed from census - low occupancy ¹			
4466 ⁸⁷	removed from census - low occupancy ¹			
4467 ⁸⁷	N	N	N	N
4468 ⁸⁷	removed from census - low occupancy ¹			
4469 ⁸⁷	♀	♀L ³	N ⁹	N
4470 ⁸⁷	N	N	N	N
4471 ⁸⁷	removed from census - low occupancy ¹			
4472 ⁸⁷	N	N	N	N
4473 ⁸⁷	N	N	N	N
4474 ⁸⁶	N	N	N	N

Spruce-Fir Non Construction Area (SFN), 2004				
Midden	Mar	Jun	Sep	Dec
4475 ⁸⁷	located off-area, new number - 5405			
4476 ^{95*}	removed from census - low occupancy ¹			
4477 ⁸⁷	N	N	N	N
4478 ^{90*}	removed from census - low occupancy ¹			
4479 ^{90*}	removed from census - low occupancy ¹			
4480 ^{90*}	burned in Nuttall fire - July 2004			
4481 ⁸⁶	removed from census - low occupancy ¹			
4482 ⁸⁶	removed from census - low occupancy ¹			
4483 ⁸⁶	removed from census - low occupancy ¹			
4484 ⁸⁶	N	N	N	N
4485 ⁸⁶	removed from census - low occupancy ¹			
4486 ⁸⁶	removed from census - low occupancy ¹			
4487 ⁸⁶	located off-area, new number - 5487			
4488 ^{91*}	removed from census - low occupancy ¹			
4489 ^{91*}	removed from census - low occupancy ¹			
4490 ^{91*}	♂	♀L	burned in Nuttall fire - July 2004 ⁴	
4491 ^{91*}	♀	♂	N	N
4492 ^{91*}	removed from census - low occupancy ¹			
4493 ^{91*}	burned in Nuttall fire - July 2004			
4494 ^{91*}	burned in Nuttall fire - July 2004			
4495 ^{95*}	burned in Nuttall fire - July 2004			
4496 ^{93*}	removed from census - low occupancy ¹			
4497 ^{93*}	burned in Nuttall fire - July 2004			
4498 ^{93*}	burned in Nuttall fire - July 2004			
4499 ^{93*}	burned in Nuttall fire - July 2004			
# Mid	27	27	14	14
# Occ	8	9	0	0
% Occ	30	33	0	0
# Sq	8	9	0	0

Appendix B - 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. After 2003, all of the removed-low occupancy middens are checked each census. Any middens that become reoccupied are added back to regular censusing.
- 2 An adult scrotal male was observed several times in the vicinity of middens 4461 and 4404 and along the hiking trail. There was little or no sign at these middens and it was not clear whether this male was resident at either of them. He may have been passing through the area, as much of time he seemed to be investigating snags and middens.
- 3 The female at midden 4469 has a natural mark. Her tail was missing hair at the tip and looked shortened.
- 4 These middens were burned in the Nuttall Fire, July 2004. The squirrels resident in June were unmarked and their fate is unknown.
- 5 A female was ear-tagged and radio-collared at midden 4419 on 30 Jun 04, just prior to the Nuttall Fire. This midden was burned and the radio signal for this animal was not detected post-fire, her fate is unknown.
- 6 A male was ear-tagged and radio-collared at midden 4422 on 30 Jun 04, just prior to the Nuttall Fire. The midden was burned, but this male was detected in the SE portion of the SFN area (unburned) and by September, had established residency at a midden near Hospital Flat.
- 7 A female was ear-tagged and radio-collared at midden 4427 on 1 July 04, just prior to the Nuttall Fire. The midden was burned, but this female was detected in the southern part of the SFN area (unburned), and by September had established residency at a midden (SO-21/8822) located approx. 200m from the SW corner of the SFN area.
- 8 A male was ear-tagged and radio-collared at midden 4449 on 1 July 04, just prior to the Nuttall Fire. The midden was burned, but this male was detected in the SE portion of the SFN area (unburned) and by September, had established residency at a midden near Hospital Flat.
- 9 A female was ear-tagged and radio-collared at midden 4469 on 30 Jun 04, just prior to the Nuttall Fire. There was no fire or suppression damage in this midden. The female was located in a nest (14001), south of the SFN area. Two juveniles were confirmed in this nest on 4 Aug 04. By September, however, this female had shifted her residency to a new midden (8825) approx. 350m S of the SFN area.

Off-Area Midden Occupancy, 2004				
Midden	Mar	Jun	Sep	Dec
TRC Area				
5101 ⁸⁹	♂ (-/- RC) 2	♂ (m/rip RC) 2	♂ (Bsq/Ysq RC) 2	♂ (Bsq/Ysq RC)
5102 ^{98*}	N	N	N	N
5103 ^{99*}	N	N	N	N
5104 ^{99*}	N	N	N	N
5105 ^{02*}	N	N	N	N
5106 ⁰²	N	N	N	N
5107 ⁰²	N	N	N	N
5114 ⁸⁹	removed from census - low occupancy ¹			
5118 ^{94*}	N ³	♂ (Y/R RC)	♂ (Y/R RC)	N ¹⁴
5119 ^{89*}	♂ (W/- RC) 4	♂ 4	♂ (Wsq/Rsq RC) 4	♂ (Wsq/Osq RC) 4
5120 ^{89*}	removed from census - too far off area			
5121 ^{89*}	♀ (B/W RC)	♀ (B/W RC)	♀ (B/W RC) 9	♀ (B/W RC)
5122 ⁸⁹	removed from census - low occupancy ¹			
5123 ⁸⁹	removed from census - too far off area			
5124 ^{90*}	removed from census - too far off area			
5125 ^{89*}	N	N	N	N
5126 ⁹¹	N	N	N	N
5127 ^{95*}	removed from census - low occupancy ¹			
5145 ^{91*}	N	N	N	N
5150 ^{91*}	N	N	N	♂ (Y/R RC) 14
5155 ^{93*}	♀ (Wsq/Wsq)	♀ (Wsq/Wsq)	♂ (B/P) 10	♂ (B/P) 10
5157 ^{93*}	removed from census - low occupancy ¹			
TRN Area				
5200 ^{93*}	♀ (Y/W RC)	N ⁷	♂ (Bsq/Wsq)	♂ (Bsq/Wsq RC)
5201 ^{99*}	removed from census - low occupancy ¹			
5202 ^{99*}	N	N	burned in Nuttall fire - July 2004	
5203 ^{00*}	N	N	N	N
5221 ^{91*}	♀ (Y/P RC)	♀ (Y/P RC)	♀ (Y/P RC)	♀ (Y/P RC)
5231 ^{96*}	N	N	N	N
5232 ^{96*}	♀	♀	♀L (Osq/Ysq RC) + 3J ¹³	♀ (Osq/Ysq RC) 13

Off-Area Midden Occupancy, 2004				
Midden	Mar	Jun	Sep	Dec
SFC Area				
5302 ^{94*}	burned in Nuttall fire - July 2004			
5307 ^{95*}	removed from census - too far off area			
5311 ^{95*}	N ⁵	♀L (G/P RC)	N ¹¹	N
5313 ^{95*}	♂ (Ysq/Wsq RC)	♂ (Psq/Psq RC) 8	N ⁸	N
5350 ⁸⁶	♀ (B/- RC) 6	♂ (O/O RC) 6	♂ (O/O RC)	♂ (O/O RC)
5351 ^{94*}	N	♂	burned in Nuttall fire - July 2004 ¹²	
5352 ^{94*}	burned in Nuttall fire - July 2004			
5353 ^{94*}	removed from census - too far off area			
5354 ^{94*}	burned in Nuttall fire - July 2004			
5355 ^{94*}	burned in Nuttall fire - July 2004			
5356 ^{94*}	burned in Nuttall fire - July 2004			
5357 ^{95*}	removed from census - low occupancy ¹			
5358 ^{95*}	burned in Nuttall fire - July 2004			
5359 ^{95*}	burned in Nuttall fire - July 2004			
5360 ^{96*}	burned in Nuttall fire - July 2004			
5361 ^{96*}	N	N	N	N
5362 ^{96*}	removed from census - low occupancy ¹			
5376 ⁸⁶	removed from census - low occupancy ¹			
5377 ⁸⁷	removed from census - low occupancy ¹			
5388 ^{92*}	removed from census - low occupancy ¹			
SFN Area				
5405 ⁸⁷	N	N	N	N
5410 ^{95*}	removed from census - low occupancy ¹			
5413 ^{95*}	N	N	N	N
5475 ⁸⁶	located on area - new number 4021			
5487 ⁸⁶	removed from census - low occupancy ¹			

Appendix B - 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. After 2003, all of the removed-low occupancy middens are checked each census. Any middens that become reoccupied are added back to regular censusing.
- 2 Male resident of 5101 (-/- RC) appears to have lost both colored ear tags. He was originally R/O. His tags are now metal/rip. He appeared to shift residency towards 1102 sometime in July, and a new resident (♂ Bsq/Ysq RC) was in midden 5101 by September.
- 3 The resident of midden 5118 (Y/R) was not seen during the March census and there was no recent sign at the midden. However, this male was observed on 5 Apr 04 near midden 1156, involved in a mating chase (8+ squirrels). Since it is not known where he is currently residing, he is not counted in the population totals for March 2004.
- 4 Male resident of 5119 (W/- RC) lost his right ear tag some time ago. The colors were originally W/B. The collar of ♂ W/- RC was found on 4 May 04. There was no sign of predation and the fate is undetermined. By June 2004, an unmarked male appeared to be resident at 5119. In September, there was still a male resident, who was trapped and ear-tagged and radio-collared early in the month.
- 5 In December 2003 there was a male sub-adult resident at midden 5311. In mid-January a male sub-adult was caught at 5311 and tagged Psq/Psq. It is likely the same male seen there in December. By March, however, midden 5311 did not appear to be occupied based on sign and observations. Male Psq/Psq was observed during the March census around 3331, where he was chased off several times by the resident female. Because his resident could not be confirmed by the end of March, he is not included in the area population totals for the month.
- 6 The female resident of midden 5350 (B/- RC) lost her right ear tag some time ago. The colors were originally B/R. The collar of ♀ B/- RC was found on 7 Jun 04. ♂ O/O RC, her son, seemed to be centered around midden 5350 in June.
- 7 The ♀ resident of 5200 (Y/W RC) was found dead near her midden on 20 May 04. There was a single puncture wound at the base of the skull, possibly a raptor kill. She had 3 juveniles in a nest approximately 200 m southwest of her midden. Two of these juveniles fell from the nest 3 days after the death of the mother and were taken into rehabilitation by the USFWS. The fate of the third juvenile is unknown.
- 8 The collar and remains of ♂ (Ysq/Wsq RC), former resident of midden 5313, were found on 24 May 04. By June, there was a new resident male (Psq/Psq RC, see footnote 5). By September, this male had moved off area to the N approx. 400m to midden CO-58/8736.
- 9 The female resident of 5121(B/W RC) was seen twice in the midden with a Subadult male. She was acting fairly tolerant of his presence, allowing close approach. He may have been her offspring from this season, but this can't be confirmed. She was thought to have been reproductive earlier in the season, but no litter was ever detected.

Appendix B - Off Area (cont.)

- 10 Female (Wsq/Wsq) was not seen after June, and a new resident had moved into midden 5155 by September. He was caught and ear-tagged (B/P) mid-month. Male (B/P) was radio-collared in mid-November. He was night nesting near a shift of midden 5155 on 3 Dec and was trapped near that location on 9 Dec. By 14 Dec, his signal was in nest 15149, located about 100m N-NE of midden 5155. The signal remained there for the rest of December data collection. His fate could not be confirmed, so he will be counted as resident at 5155 for the month of December, as he was seen alive early in the month.
- 11 The former resident of 5311, female (G/P RC), by September had moved residency to a shift of nearby midden EM-08/8735, about 30m S of 5311. She is still sometimes observed in the areas around midden 5311.
- 12 Midden 5351 was burned in the Nuttall Fire, July 2004. The fate of the unmarked male June resident is unknown.
- 13 The resident female at midden 5232 (Osq/Ysq RC) was observed on 7 August moving 4 small juveniles from a nest near 2208 to a nest near 5350. However, during the September census, only 3 juveniles were observed. This female was seen near midden 5232 on 5 Dec 04. After that time, her radio signal was located under snow near midden 5231. She was not seen through the rest of the month. However midden 5232 still looked active, and the fate of this female could not be determined, so she was counted as resident for the month of December, as she was seen alive during the month. [Note - this female was seen alive in Jan 05, she had apparently lost her radio collar].

Appendix C. Quarterly population summaries for Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas, Pinaleno Mountains, Arizona, March 2000 - December 2004.

Date	TRC	TRN	SFC	SFN	TOTAL
Mar 2000	31	29	12	16	88
June 2000	31 + 3J	29 + 2J	12	9	81 + 5J
Sep 2000	25	21	12	10	68
Dec 2000	21	21	12	11	65
Mar 2001	18	10	3	3	34
June 2001	19	12	4	4	39
Sep 2001	18 + 7J	8	3 + 4J	0	29 + 11J
Dec 2001	23 + 2SA	10	4	4	41 + 2SA
Mar 2002	21	7	4	4	36
Jun 2002	22 + 23J	6 + 4J	4	2	34 + 27J
Sep 2002	22 + 3J/SA	5	4 + 2J/SA	3	34 + 5J/SA
Dec 2002	14	4	2	1	21
Mar 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
Mar 2004	11	5	8	8	32
Jun 2004	8 + 2J	5 + 3J	6	9	28 + 5J
Sep 2004	12 + 2J	4 + 5J	3	0	19 + 7J
Dec 2004	12	3	3	0	18

Appendix D: Quarterly occupancy maps for Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas, Pinaleño Mountains, Arizona, March 2004 - December 2004.

Appendix E: Measures of spatial distribution for Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) and middens on RSMP study areas, Pinaleno Mountains, Arizona, 2004.

E-1. Crude Density

a) middens

b) red squirrels

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

Appendix E-1a: Quarterly Crude Density (middens/ha) of **middens** on RMSP study areas, Pinaleno Mountains, Arizona, December 2003 - December 2004.

DATE	TRC	TRN	SFC	SFN
Area ¹ (after Jan 00)	51.1 ha	21.0 ha	76.0 ha	104.8 ha
Dec 2003	0.72	1.67	0.47	0.30
Mar 2004	0.61	1.29	0.37	0.26
Jun 2004	0.61	1.29	0.37	0.26
Area ² (after Jul 04)	51.1 ha	19.8 ha	58.5	34.1
Sep 2004	0.61	1.36	0.36	0.41
Dec 2004	0.65	1.36	0.36	0.41

Appendix E-1b: Quarterly Crude Density (squirrels/ha) of Mt. Graham **red squirrels** (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas, Pinaleno Mountains, Arizona, December 2003 - December 2004.

DATE	TRC	TRN	SFC	SFN
Area ¹ (after Jan 00)	51.1 ha	21.0 ha	76.0 ha	104.8 ha
Dec 2003	0.22	0.29	0.11	0.11
Mar 2004	0.22	0.24	0.11	0.08
Jun 2004	0.20	0.38	0.08	0.09
Area ² (after Jul 04)	51.1 ha	19.8 ha	58.5	34.1
Sep 2004	0.27	0.45	0.05	0.00
Dec 2004	0.23	0.15	0.05	0.00

- 1 The new area sizes after Jan 2000 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).
- 2 The reduction in the size of the monitored areas after July 2004 was due to the Nuttall Fire. The areas removed were severely burned and are no longer suitable habitat.

Appendix E-2. Local Density (number within 100m radius) and Nearest Neighbor Distances of **middens** and Mt. Graham **red squirrels** (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas, Pinaleño Mountains, Arizona, December 2003 - December 2004.

TRC Area										
Middens						Squirrels				
Month	# Mid ¹	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 03	37	5.6	0.47	42.3	2.86	11	1.8	0.30	81.2	12.68
Mar 04	31	4.4	0.35	44.8	3.24	11	2.1	0.39	78.5	13.52
Jun 04	31	4.4	0.35	44.8	3.24	8	1.4	0.32	95.7	14.87
Sep 04	31	4.4	0.35	44.8	3.24	12	1.3	0.25	83.8	8.25
Dec 04	33	4.7	0.39	41.2	2.49	12	1.4	0.29	68.9	11.96

TRN Area										
Middens						Squirrels				
Month	# Mid ¹	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 03	35	5.5	0.30	44.3	2.84	6	0.7	0.33	107.4	10.06
Mar 04	27	4.3	0.24	50.2	3.07	5	1.0	0.55	100.7	9.24
Jun 04	27	4.3	0.24	50.2	3.07	5	0.2	0.20	147.7	17.32
Sep 04	27	4.3	0.24	50.2	3.07	4	1.0	0.41	92.6	5.65
Dec 04	27	4.3	0.24	50.2	3.07	3	0.7	0.33	96.7	5.42

¹ The number of middens from December 2003 to March 2004 was reduced as several middens were removed from regular censusing due to historical low or non-occupancy. The number of middens from June 2004 to September 2004 was a reduced due to severe damage from the Nuttall Fire, July 2004.

Appendix E-2 (con't.)

SFC Area										
Middens						Squirrels				
Month	# Mid ¹	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 03	36	2.3	0.19	65.5	5.01	8	0.6	0.26	116.0	20.38
Mar 04	28	1.8	0.23	72.1	6.21	8	0.4	0.18	172.0	45.56
Jun 04	28	1.8	0.23	72.1	6.21	6	0.3	0.21	187.1	54.94
Sep 04	21	1.7	0.29	79.0	9.17	3	0.0	0.00	311.8	69.49
Dec 04	21	1.7	0.29	79.0	9.17	3	0.0	0.00	311.8	69.49

SFN Area										
Middens						Squirrels				
Month	# Mid ¹	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 03	32	1.3	0.16	83.7	8.58	11	0.4	0.15	161.9	36.09
Mar 04	27	0.8	0.15	103.6	11.83	8	0.3	0.16	160.2	22.71
Jun 04	27	0.8	0.15	103.6	11.83	9	0.4	0.18	123.4	21.71
Sep 04	14	1.4	0.23	88.7	18.65	0	--	--	--	--
Dec 04	14	1.4	0.23	88.7	18.65	0	--	--	--	--

1 The number of middens from December 2003 to March 2004 was reduced as several middens were removed from regular censusing due to historical low or non-occupancy. The number of middens from June 2004 to September 2004 was a reduced due to severe damage from the Nuttall Fire, July 2004.

All Areas Combined										
(including only middens and red squirrels on the monitored areas)										
Middens						Squirrels				
Month	# Mid ¹	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 03	172	3.9	0.21	57.7	2.49	49	0.9	0.13	111.5	11.05
Mar 04	113	2.9	0.20	66.9	4.01	32	1.0	0.22	125.8	14.94
Jun 04	113	2.9	0.20	66.9	4.01	28	0.6	0.15	133.5	15.15
Sep 04	93	3.3	0.21	60.7	4.10	19	1.0	0.20	121.6	22.12
Dec 04	95	3.4	0.23	59.1	4.03	18	1.1	0.24	114.0	24.96

¹ The number of middens from December 2003 to March 2004 was reduced as several middens were removed from regular censusing due to historical low or non-occupancy. The number of middens from June 2004 to September 2004 was a reduced due to severe damage from the Nuttall Fire, July 2004.

Appendix F: Reproductive success of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas, Pinaleño Mountains, Arizona, 2004.

F-1: Mt. Graham red squirrel breeding chases seen on RSMP study areas.

F-2: Mt. Graham red squirrel litters seen on RSMP study areas.

F-3: Mt. Graham red squirrel reproductive status and age statistics for quarterly censuses.

Appendix F-1: Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) breeding chases observed on RSMP study areas, Pinaleño Mountains, Arizona, 2004.

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
5 Apr 04	1156	Observed a breeding chase with female resident of 1156 (ID 202) and at least 4 males. The male residents of middens 1153 (ID 9), 1170 (ID 14), and 1116 (ID 156), and at least one unmarked male were involved in the chase. The female was observed a few times chasing the males.

Appendix F-2: Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) litters on or near RSMP study areas, Pinaleño Mountains, Arizona, 2004.

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
23 May 04	5200	The resident female (ID 44) was found dead near her midden on 20 May 04, with an apparent raptor wound. While observing at her known maternity nest (12039), 3 juveniles were seen. Two of the juveniles fell out of the nest and were taken in to care and immediately turned over to the USFWS for rehabilitation. The fate of the third juvenile is unknown.
27 Jun 04	2210	For the resident female (ID 68) 3 juveniles were confirmed on this date in maternity nest (12045).
2 Jul 04	1131	One juvenile was first seen on 28 Jun 04. After multiple observations 2 juveniles and mother (ID 153) were confirmed in maternity nest (11097).
20 Jul 04	5221	The female (ID 39) resident was observed carrying 2 juveniles into nest 11101 near midden 1121. Two juveniles were again observed on 3 Aug 04. On 19 Aug 04, the adult female was observed chasing two large juveniles away from nest 11101.
4 Aug 04	4469	A female was ear-tagged and radio-collared at midden 4469 on 30 Jun 04, just prior to the Nuttall Fire. There was no fire or suppression damage in this midden. The female was located after the fire, in a nest (14001), south of the SFN area. 2 juveniles were confirmed in this nest on 4 Aug 04. By September this female had shifted her residency to a new midden (8825) approx. 350m S of the SFN area.
7 Aug 04	5232	The female (ID 458) was observed moving 4 juveniles from nest 12014 near midden 2208 to nest 15142 near midden 5232 on 7 Aug 04. In late Aug/early Sep, only 2 juveniles were seen at nest 15142.

Appendix F-2 (cont.)

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
9 Aug 04	near 3019	Female (ID 337) was resident at midden 3366 prior to the Nuttall Fire in Jul 04. After the fire she began to differ locations on the SFC. On, 20 Jul 04 she was observed carrying 2 juveniles into nest 13136 south of midden 3366. On 9 Aug 04, 3 juveniles were confirmed at nest 13141 NE of midden 3366. The adult female and one juvenile were seen entering nest 15318 near midden 5377 on 19 Aug 04. On 30 Aug 04, the female and one large juvenile were seen entering nest 15306, north of midden 5353. By September, the adult female had established residency at midden CO-58/8736 about 250m N of the SFC area.
24 Aug 04	1113	The female (ID 202) was resident at midden 1156 in Jun 04, but began to shift activity near midden 1113 in Jul/Aug. A maternity nest 11042 was located nearby and 3 juveniles were confirmed on 20 Aug 04. By December, the adult female shifted her residency back to midden 1156.
3 Sep 04	2242	During an examination during trapping, female (ID 16) was thought to be pregnant with young palpated. In Jun/Jul her reproductive status was unclear, but she did not appear to be lactating and no juveniles were ever seen. On 2 Sep 04, she was noted to be lactating again and 5 juveniles were confirmed in nest 12049 on 3 Sep 04. It appears that this female may have lost her first litter of the season, but was able to successfully produce a second litter later in the season.

Appendix F-2 (cont.)

<u>Date</u>	<u>Midden</u>	<u>Notes</u>
Females that were reproductive, but no litters observed:		
3 Jun 04	5311	The resident female (ID 318) was noted to be lactating during a trapping examination. By her next capture on 25 Jun 04, the hair around the nipples was regrowing, and no milk was expressed.
Jun 04	4427	A lactating unmarked female was resident at this midden during the Jun 04 census. This midden was burned in the Nuttall Fire, Jul 04 and the fate of this female was unknown.
Jun 04	4490	A lactating unmarked female was resident at this midden during the Jun 04 census. This midden was burned in the Nuttall Fire, Jul 04 and the fate of this female was unknown.
Jun/Jul 04	5121	The female (ID 23) resident of this midden was noted to be lactating from examinations during trapping, but no litter was ever observed. During the Sep 04 census, a sub-adult male was observed twice in close proximity to the adult female. He may have been her offspring, but this can not be confirmed.

Appendix F-3: Quarterly reproductive status and age information for Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*) on or near RSMP study areas, Pinaleno Mountains, Arizona, 2004. Only information on the final resident each month is given. Information on non-resident squirrels and middens thought to be active based on sign alone (Y) is not included. Therefore the total number of active middens for a quarter may be higher than the totals of numbers here. **Information for off-area middens (5000s) is included in Appx F3a-c.** Information on reproductive condition is taken from trapping records or visual assessment if no trapping data is available.

Appendix F-3a: Female reproductive information

Reproductive Status	March			June			September			December		
	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.
reproductive ²				4								
lactating ²				6			3					
recent lactation ²							4			7		
past lactation ²												
non-reproductive ¹	13	2 ^{SA}		2	1 ^J				1		1 ^{SA}	
unknown	3			3			1			1		

- 1 J/SA - Juveniles are still living at the maternal midden. Subadult squirrels have dispersed and are living independently. Subadults may be identified by examination during trapping or visual cues: generally smaller size, whiter fur on underside, thinner tail, head may appear slightly large (out of proportion).
- 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 F-3b: Male reproductive information.

Reproductive Status	March			June			September			December		
	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.
scrotal	16			24						4		
partially scrotal												
non-reproductive ¹					1 ¹		13		1			
unknown			1				5					1

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

March			June			September			December		
Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.	Adult	J/SA ¹	Unkn.
33	5 ^{SA}	2	39	5 ^J	0	26	10 ^J	2	26	1 ^{SA}	0

1 J/SA - Juveniles are still living at the maternal midden. Subadult squirrels have dispersed and are living independently. Subadults may be identified by examination during trapping or visual cues: generally smaller size, whiter fur on underside, thinner tail, head may appear slightly large (out of proportion).

Appendix G. Weather information for RSMP study areas, Pinaleño Mountains, Arizona, January - December, 2004.

G-1: Monthly weather summaries

G-2: Accumulated snow depths

Appendix G-1. Monthly weather summaries for RSMP study areas, Pinaleño Mountains, Arizona, January -December, 2004.

Note: Averages are calculated based on the total number of records collected per month. As of 25 September 2000, weather stations are recording data at 1 hour intervals: between approximately 600 and 700 records per month. Biology Camp weather data from May to September 2004 were obtained from the RAWS weather station at Columbine, as weather stations were disassembled due to the Nuttall Fire Complex. No outside data were available for Emerald Peak, so records from May to September are missing.

	Month	Biology Camp	Emerald Peak
Temperature (°C) average (max; min)	January	-2.7 (8.6; -13.2)	-4.2 (2.6; -14.6)
	February	-4.6 (8.7; -14.5)	-5.9 (9.4; -16.2)
	March	3.3 (13.8; -13.0)	-13.5 (12.7; -13.5)
	April	2.4 (12.3; -8.1)	0.8 (9.5; -8.3)
	May	9.5 (22.2; -5.6)	– ¹
	June	12.6 (23.9; -1.7)	– ¹
	July	13.9 (25.0; 3.3)	– ¹
	August	12.0 (25.0; 2.2)	– ¹
	September	8.9 (22.8; -4.4)	– ¹
	October	5.0 (15.8; -6.4)	3.7 (13.7; -7.6)
	November	-0.6 (12.2; -15.4)	-2.0 (9.4; -17.3)
	December	-0.9 (12.8; -14.7)	-1.9 (10.9; -16.9)

	Month	Biology Camp	Emerald Peak
Wind Speed (m/sec), maximum(max. gust)	January	2.2 (13.0)	2.7 (13.0)
	February	3.1 (12.5)	2.2 (10.7)
	March	2.2 (8.0)	3.1 (11.2)
	April	3.6 (21.0)	3.1 (13.0)
	May	5.4 (12.5)	– ¹
	June	4.9 (10.7)	– ¹
	July	4.5 (9.8)	– ¹
	August	3.6 (8.5)	– ¹
	September	4.5 (9.4)	– ¹
	October	2.2 (11.6)	4.0 (11.6)
	November	3.1 (10.7)	5.4 (14.3)
	December	2.7 (11.2)	3.6 (17.0)
Wind, Most Common Direction	January	SW	S-SE
	February	E-NE	N
	March	W-SW	N
	April	W-SW	N
	May	– ¹	– ¹
	June	– ¹	– ¹
	July	– ¹	– ¹
	August	– ¹	– ¹
	September	– ¹	– ¹
	October	W	E-NE
	November	W-SW	E-NE
	December	W	NE

	Month	Biology Camp	Emerald Peak
Maximum Snow Depth (cm) Forest/Clearing	January	55/71	51/67
	February	82/74	92/81
	March	113/154	132/130
	April	0/28	69/24
	May		
	June		
	July		
	August		
	September		
	October		
	November	10/8	18/30
	December	33/40	54/69
Rain Fall (mm) Total	January	_ ²	_ ²
	February	_ ²	_ ²
	March	_ ²	_ ²
	April	_ ²	_ ²
	May	_ ²	_ ²
	June	4.6	_ ¹
	July	33.2	_ ¹
	August	6.8	_ ¹
	September	9.9	_ ¹
	October	8.6	_ ¹
	November	_ ³	_ ³
	December	_ ³	_ ³

	Month	Biology Camp	Emerald Peak
Relative Humidity (%) average (max; min)	January	15.0 (100.0; 75.5)	71.4 (95.0; 7.0)
	February	61.7 (98.0; 17.0)	54.0 (93.0; 7.0)
	March	61.8 (99.0; 16.0)	55.8 (95.0; 9.0)
	April	61.4 (100.0; 21.0)	56.1 (95.0; 11.0)
	May	32.9 (89.0; 0.0)	– ¹
	June	33.6 (96.0; 9.0)	– ¹
	July	58.2 (100.0; 10.0)	– ¹
	August	71.2 (100.0; 18.0)	– ¹
	September	68.0 (100.0; 17.0)	– ¹
	October	68.6 (100.0; 17.0)	61.4 (97.0; 13.0)
	November	66.88 (100.0; 12.0)	59.9 (96.0; 5.0)
	December	53.9 (100.0; 13.0)	42.7 (97.0; 6.0)
Dew Point (°C) average (max; min)	January	-23.6 (1.1; -23.6)	-10.0 (-1.0; -33.9)
	February	-11.9 (-1.0; -27.8)	-15.5 (-2.8; -37.1)
	March	-4.3 (5.6; -17.9)	-7.8 (3.3; -29.5)
	April	-5.4 (2.2; -18.1)	-8.5 (0.3; -26.1)
	May	-7.3 (1.7; -19.1)	– ¹
	June	-18.2 (7.6; -18.2)	– ¹
	July	3.9 (14.3; -17.2)	– ¹
	August	6.0 (14.1; -11.9)	– ¹
	September	2.2 (10.6; -13.5)	– ¹
	October	-1.2 (7.6; -18.3)	-4.4 (5.3; -24.6)
	November	-7.6 (4.9; -28.3)	-11.4 (3.1; -35.8)
	December	-11.1 (3.2; -27.6)	-16.5 (1.6; -37.4)

Appendix G-1 (cont.)

- 1 No data were available during this period as the weather stations were off-line due to the Nuttall Fire Complex.
- 2 The rain gauges were disconnected on 6 Dec 03. All moisture during the winter and spring was in the form of snow. The rain gauges were reconnected in May 04.
- 3 The rain gauges were disconnected in Dec 04 and will be reconnected in the spring after the snow melt. Any precipitation in November was snow, so not included here.

Appendix G-2. Monthly maxima, minima and averages for accumulated snow depth on RSMP study areas, December 2003 - April 2004. Data are from snow poles in Spruce-Fir (SF) and Mixed Conifer (TR) habitats from locations in clearings (C) and forest (F) locations.

Month	Hab	Loc	N ¹	Average snow depth (cm)	Maximum snow depth (cm)	Minimum snow depth (cm)
Dec 2003	TR	C	1	10.0	10	10
Dec 2003	TR	F	1	13.0	13	13
Dec 2003	SF	C				
Dec 2003	SF	F				
Jan 2004	TR	C	13	40.0	76	0
Jan 2004	TR	F	14	31.9	72	9
Jan 2004	SF	C	9	52.1	85	14
Jan 2004	SF	F	6	43.3	68	22
Feb 2004	TR	C	6	70.3	92	56
Feb 2004	TR	F	6	71.5	83	60
Feb 2004	SF	C	6	79.3	95	66
Feb 2004	SF	F	6	74.0	99	48
Mar 2004	TR	C	4	109.8	154	74
Mar 2004	TR	F	4	87.5	113	59
Mar 2004	SF	C	8	121.8	188	63
Mar 2004	SF	F	8	175.4	580	100
Apr 2004	TR	C	6	20.5	70	0
Apr 2004	TR	F	6	18.2	63	0
Apr 2004	SF	C	3	24.7	50	0
Apr 2004	SF	F	3	43.0	69	0

1 N represents the number of snow pole readings in each area per month. 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. Not all sets of poles may be read every month.

Appendix H: Impacts of Nuttall Fire Complex, June - July 2004, on Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), middens, and RSMP study area size, Pinaleño Mountains, Arizona.

The Nuttall Fire Complex began as two lightning started fires on 22Jun 04 (Gibson Fire) and 26 Jun 04 (Nuttall Fire) and the two fires merged on 2 Jul 04. The fire perimeter covered most of the northeast half of the Pinaleño range at elevations from 1371m to the highest point in the range, Mt. Graham at 3267m. The fires were contained after 19 Jul 04, and the USFS Burned Area Response Team (BAER) estimated the total fire size at 12029 hectares. Of this area, 6354ha were estimated at low/unburned severity, 4593ha at moderate severity, and 1083ha at high severity. For more detailed information on the Nuttall Fire Complex over the whole Pinaleño range, see the following websites:

<http://www.fireteam-sw.com/oltrogge/incidents/nuttall/>
<http://medusa.as.arizona.edu/lbto/july04/nuttallcomplex.htm>

The Nuttall Fire on the UA Monitored Areas

Appendix H-1: Fire effects on Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) **middens** and RSMP study area size.

During the September 2004 quarterly census, each midden on the monitored areas was visited and assessed for fire and suppression damage to the substrate, vegetation, and canopy strata within a 10m radius of the tag tree, using the matrix below (adapted from Nature Conservancy/National Park Service methods). Some middens/tag trees could not be located in the severely burned areas, therefore assessments were made at estimated locations.

	0 Unburned	1 Scorched	2 Lightly Burned	3 Moderately Burned	4 Heavily Burned	N/A Not Applicable
S Substrate (litter/duff)	not burned	litter partially blackened; duff nearly unchanged wood/leaf structures unchanged	litter charred to partially consumed; upper layer of duff burned; wood/leaf structure charred but recognizable	litter mostly to entirely consumed; leaching coarse light colored ash; duff deeply burned; wood/leaf structures unrecognizable	litter and duff consumed, leaving fine white ash; mineral soil visibly altered; often reddened or glazed	inorganic (rock)
V Vegetation Understory brush/herbs (<2.5m tall)	not burned	foliage scorched and attached to supporting twigs	foliage and smaller twigs partially to completely consumed	foliage, twigs, and small stems consumed	all plant parts consumed, leaving some or no major stems/trunks	not present prior to fire

Appendix H-1a: Damage to Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) middens on the monitored areas by fire or fire suppression, Nuttall Fire Complex, Jun-Jul 04. Middens in the severe category were permanently removed from the census. TRC = transitional forest in the construction zone, TRN = transitional forest outside of the construction zone, SFC = spruce-fir forest in the construction zone, SFN = spruce-fir forest outside of the construction zone.

Damage Type	number of middens affected					Total (388)
	TRC (50) ¹	TRN (47)	SFC (116)	SFN (122)	Off-Area ² (53)	
severe burn or suppression (burn codes 3-4)	0	2	24	78	10	114
light/moderate burn (burn codes 1-2)	0	0	19	4	2	25
some suppression w/in 10m of midden center	0	0	7	2	0	9
some suppression w/in 25m or midden center	0	1	3	1	0	5

- 1 The number of known middens on each area prior the Nuttall Fire.
- 2 Middens just outside the boundaries of the monitored areas that are censused for additional population and density data. This number includes middens around all 4 of the other areas.

Appendix H-1b: Changes in size of RSMP study areas following the Nuttall Fire June -July 2004. The areas removed were severely burned and can no longer be considered suitable red squirrel habitat. Measurements for areas of severe burn were made in ArcView combining information from BAER team estimates and RSMP field assessments. TRC = transitional forest in the construction zone, TRN = transitional forest outside of the construction zone, SFC = spruce-fir forest in the construction zone, SFN = spruce-fir forest outside of the construction zone. (See also Figure 1)

	TRC	TRN	SFC	SFN	Total
Area prior to NF (ha)	51.12	20.85	75.90	104.81	252.68
Area lost to NF (ha)	0.00	1.04	17.42	70.68	89.14
New areas - post NF (ha)	51.12	19.81	58.59	34.14	163.56

Appendix H-2: Nuttall Fire Complex effects on Mt. Graham red **squirrels** (*Tamiasciurus hudsonicus grahamensis*) on RSMP study areas.

The effects of the Nuttall Fire on red squirrels on the monitored areas are less defined than direct fire impacts to middens. Indeed, the effects may not be fully understood for years as the impact of the major loss of potential squirrel habitat becomes more clear. We were able however, to glean some information on red squirrel response and survival after the Nuttall Fire from the quarterly census data for June and September with additional information from telemetry studies. Below is a summary of the pre-fire occupancy status of the middens severely damaged and permanently removed from censusing.

Appendix H-1a: Pre-fire (Jun 2004) occupancy status of middens severely damaged in Nuttall Fire June - July 2004. TRC = transitional forest in the construction zone, TRN = transitional forest outside of the construction zone, SFC = spruce-fir forest in the construction zone, SFN = spruce-fir forest outside of the construction zone.

Pre-fire occupancy status (Jun 2004)	number of middens in each occupancy category					
	TRC (0) ¹	TRN (2)	SFC (24)	SFN (78)	Off-Area ² (10)	Total (114)
Occupied	0	0	2	7	1	10
Possibly Occupied	0	0	1	0	0	1
Not Occupied	0	2	4	6	9	21
Previously Removed ³ (unoccupied)	0	0	17	65	0	82

- 1 The number of known middens severely damaged and removed from censusing following the Nuttall Fire.
- 2 Middens just outside the boundaries of the monitored areas that are censused for additional population and density data. This number includes middens around all 4 of the other areas.
- 3 These middens had been previously removed from regular censusing due to historical low or non-occupied status. However, all these middens were visited in Jun 2004, and found to be unoccupied. See methods section in Annual Report for details.

Appendix H-1a (cont.):

Of the 10 middens that were occupied in June, but were destroyed by the Nuttall Fire, the fate of the resident squirrels is as follows:

- SFC area: 1 squirrel was unmarked and not seen following the fire, fate unknown
 1 squirrel was radio-collared, but not located following the fire, fate unknown
- SFN area: 3 squirrels were radio-collared and located alive following the fire
 1 squirrel was radio-collared and not seen following the fire, fate unknown
 3 squirrels were unmarked and not seen following the fire, fate unknown
- Off area: 1 squirrel was unmarked and not seen following the fire, fate unknown

Appendix H-1b: Detailed accounts of Mt. Graham red **squirrels** (*Tamiasciurus hudsonicus grahamensis*) on and near RSMP study areas, Pinaleño Mountains, Arizona, in and near areas affected by the Nuttall Complex Fire, June - July 2004.

SFC Area

<u>Midden</u>	<u>Notes</u>
3331	An unmarked female was resident in Jun 2004, midden was severely burned and the female was not seen after the fire, fate unknown.
3360	A marked male (ID 331) was resident in Jun 2004, there was no fire or suppression damage to this midden, squirrel remained at midden following fire.
3365	A marked male (ID 332) was resident in Jun 2004, there was no fire or suppression damage directly in the midden (w/in 10m), but there was some heavy tree thinning nearby. The squirrel remained in the midden following the fire.
3366	Female (ID 337) was resident in Jun 2004, before the Nuttall fire. There was no direct damage to the midden but a dozer line was about 15m east. The female was located after the fire in late July, in the area N of midden 3366. She was located in a maternity nest 13141, NE of midden 3019. Three juveniles were observed at this nest on 9 Aug 04. By 19 Aug, this female had moved her litter to a new nest, 15318, N of midden 5377. On 30 Aug, 1 large juvenile was seen following the female into nest 15306 near midden 5350. By September, female (Ysq/Psq RC) had established residency at midden CO-58/8736 located about 250m N of the SFC area.
3378	A marked female (ID 319) was resident during the Jun 2004 census, however this female was last seen in an area well south from her midden in mid-June. She was not seen after this time and her fate is unknown. There was no fire or suppression damage to this midden.
3397	A marked male (ID 336) was resident in Jun 2004. The midden was burned and the male was not located following the fire, fate unknown.

Appendix H-1b: (cont.)

SFN Area

<u>Midden</u>	<u>Notes</u>
4008	An unmarked male was resident in Jun 2004. The midden was severely burned, male not seen following fire, fate unknown.
4419	An unmarked male was resident in Jun 2004. However, a female (ID 444) was captured and marked at this midden on 30 Jun 2004. The midden was severely burned, and the female was not located following the fire, fate unknown.
4422	An unmarked male was resident in Jun 2004. A male (ID 439) was captured and marked at this midden on 30 Jun 04. The midden was severely burned, but this male was detected in the SE portion of the SFN area (unburned) and by September, had established residency at a midden near Hospital Flat.
4427	An unmarked female was resident in Jun 2004. A female (ID 437) was captured and marked at this midden 1 Jul 04. The midden was severely burned, but this female was detected in the southern part of the SFN area (unburned), and by September had established residency at a midden (SO-21/8822) located approx. 200m from the SW corner of the SFN area.
4435	An unmarked male was resident in Jun 2004. The midden was severely burned and the male was not located following the fire, fate unknown.
4449	An unmarked male was resident in Jun 2004. A male (ID 435) was captured and marked at this midden on 1 Jul 04. The midden was burned, but this male was detected in the SE portion of the SFN area (unburned) and by September, had established residency at a midden near Hospital Flat.
4469	An unmarked female was resident in Jun 2004. A female (ID 433) was captured and marked at midden 4469 on 30 Jun 04. There was no fire or suppression damage in this midden. The female was located in a nest (14001), south of the SFN area. Two juveniles were confirmed in this nest on 4 Aug 04. By September, this female had shifted her residency to a new midden (8825) approx. 350m S of the SFN area.
4490	An unmarked lactating female was resident in Jun 2004. The midden was severely damaged and the female was not seen following the fire, fate unknown.
4491	An unmarked male was resident in Jun 2004. There was no fire or suppression damage to this midden, but the male was not seen following the fire, fate unknown.
5351	An unmarked male was resident in Jun 2004. There was no fire or suppression damage to this midden, but the male was not seen following the fire, fate unknown.