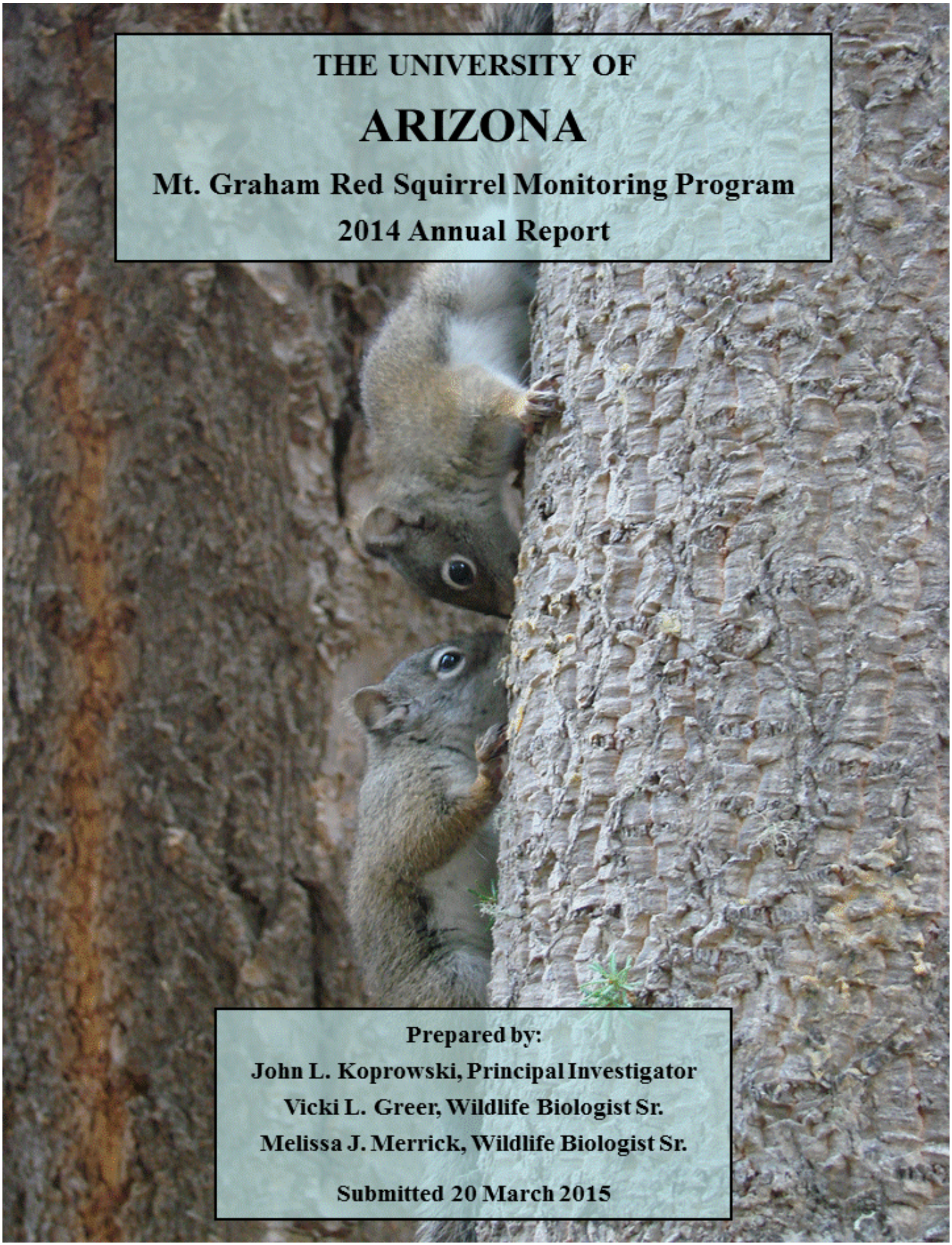

THE UNIVERSITY OF ARIZONA

Mt. Graham Red Squirrel Monitoring Program

2014 Annual Report

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EXECUTIVE SUMMARY

In 2014, the University of Arizona Mt. Graham Red Squirrel Monitoring Program continued efforts to document aspects of red squirrel population biology and food resources in the established study areas around the Mt. Graham International Observatory in the Pinaleño Mountains, Graham County, Arizona.

Overall annual mushroom production (sum of $\bar{x}$ wet weight for all areas) in 2014 was 337.6 kg/ha, slightly larger than in 2013 (268.8 kg/ha). The 2014 mushroom crop ranked 4th highest of 21 years since data collection began in 1994. The total 2013 seed crop (one year delay due to methodology) ranked 11th highest in 21 years of data collection. For comparison to recent years, the 2013 overall mean seed crop was 622.9 (1000 seeds/ha), smaller than the 2012 crop, 10216.5 (1000 seeds/ha), but larger than in 2011, 5.9 (1000 seeds/ha)

Overwinter survival, calculated as animals surviving from December 2013 to June 2014, was 56.8% (25 of 44 squirrels surviving) in transitional (TR) habitat and 55.6% (5 of 9 squirrels surviving) in spruce-fir (SF) habitat. In December of 2013 there were 13 radio collared and/or ear-tagged squirrels on or near the monitored areas. By June 2014, 9 of these animals were alive, 2 were unconfirmed dead (collar only found, animal not seen thereafter), 1 was confirmed dead (remains found) and 1 had disappeared, fate unknown.

A complete census of the study areas was made in March, June, September, and December 2014. Squirrel populations in December 2014 (58 adults/subadults) were higher than the previous December (53 adults/subadults). In both TR and SF habitats, the number of squirrels increased throughout the year. Thirteen litters were confirmed on or near the monitored areas in 2014. From these 13 litters, 31 juveniles were known to have emerged from natal nests. The total number of squirrels on the monitored areas in September 2014 (59: 53 adults + 6 juveniles) was the highest since June 2002 (61: 34 adults + 27 juveniles).

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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° 42' N, 109° 53' W). In 2014, the MGIO site consisted of three operating facilities, the Vatican Advanced Technology Telescope (VATT), the Sub-Millimeter Telescope (SMT), and the Large Binocular Telescope (LBT), a maintenance and generator building, and a 3.2 km access road (FR 4556). Herein, we report on the monitoring efforts from 1 January to 31 December 2014.

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 m 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 (C.C. 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. Activity areas are assigned a temporary number and are revisited to assess 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.

Prior to 2003, at the end of each calendar year, a list of middens to be removed from regular censusing was compiled. If a midden had been censused for at least three years (12 censuses), including at least one good seed crop (better than the mean seed crop over the study period), and was not occupied during that time, the midden was removed from the list for regular censusing and revisited only each December. If any removed middens became reoccupied, the sites are returned to the list for regular census. However, 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 the early 1990s, to determine the abundance of major red squirrel food resources: conifer seeds (1993) and mushrooms (1994). In July 2004, 14 of the original seed plots in SFC (7) and SFN (7) were in areas destroyed by the Nuttall Fire. We added 3 new plots in late summer 2004 (SFC - 2, SFN - 1) in remaining unburned areas. Therefore, seed production is estimated from 20 seedfall plots distributed among the monitored areas (Figure 1). Three 0.25 m^2 seed traps were randomly placed within a 10 m x 10 m plot at each location. Seeds from the 2013 crop were collected from the seed traps in June 2014. Conifer seeds contained in each trap were separated by species and individually tested to determine the proportion of seeds that were “filled” (most likely to be viable). A filled 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 1 m by 100 m (0.01 ha) at two week intervals during periods of mushroom production. Fourteen of 28 food resource plots were destroyed in the Nuttall Fire in July 2004, however, three new plots were established in remaining unburned areas on the SFC (2) and SFN (1). Mushrooms (epigeous or above-ground fungi) were collected at these 20 sites (Figure 1) from late July through early October 2014. Mushrooms in 2014 were collected on north-south transects. We alternate plot collection orientation every five years in order to avoid possible impacts of long-term harvest on plots. Prior to beginning the alternating orientations, we collected mushrooms from both east-west and north-south plots in 2001 and detected no significant differences in weight, number, or diversity of mushrooms between the two orientations. 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 to the nearest 0.1 g. 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 ($n < 100$).

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 (Appendix A) in addition to the current year's mushroom data (Tables 4, 5).

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 2014, 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 2014, many 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 dependent 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 on the monitored areas. During a complete census in December 2013, the number of occupied middens and the identity of resident squirrels were determined. December 2013 occupancy was then compared to occupancy for June 2014. 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 the following 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.

Reproductive Activity and Success

In 2014, 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 reproductive status of females 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 permits issued by United States Fish and Wildlife Service Endangered Species (TE041875) and Arizona Game and Fish Department (SCP-2014: 654189), using accepted methods (Koprowski 2002), we trapped red squirrels using wire-mesh box-type live traps (Tomahawk Co., model 201), baited with peanuts and/or peanut butter. Once captured, we transferred squirrels to a cloth-handling cone for marks and measurements. We tagged squirrels with small numbered metal ear-tags (National Band & Tag Co., style 1005-1) threaded with colored plastic washers (National Band & Tag Co., ⅜" diameter, style 1842) and affixed to ears for easy distance identification. Radio collars (Wildlife Materials Inc., model SOM2190) were fitted on some adult (collar weight ~7 g). Squirrels were released at the capture site.

Mapping

All middens and most other physical features on the monitored areas were previously mapped using GPS with an accuracy of ± 5 m. Any new GPS data (middens, nests, etc.) were collected using GeoXM or GeoXT units from Trimble Navigation, Inc. Readings were taken within 5 m of the location center. 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 3.3 (ESRI 2002).

Weather Data

Weather data were collected using a Weather Monitor II station (Davis Instruments, www.davisnet.com) located at the Biology Camp (32" 41' 51.47 N, 109" 54' 20.28 W), adjacent to the TRC. The station records air temperature, wind speed, wind direction, rainfall, relative humidity and barometric pressure. Data are averaged at 60 min intervals and minimum, maximum and mean values are recorded. Snow depth (cm) was recorded from five 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.

Statistical Analyses

All statistical analyses were conducted using standard tests found in IBM SPSS statistical software (Ver. 19, www.spss.com). Because sample sizes were sometimes small due to endangered status, significance for statistical tests was implied when $P \leq 0.05$ and potential biological significance was noted when $P < 0.10$.

RESULTS

Red Squirrel Food Resources

2013 Conifer Seed Production

Data collection for seed crops began in 1993 and yearly production is currently reported as the mean number of 1000 *filled* seeds per hectare. If years are ranked from highest (1) and lowest (21), the total 2013 seed crop ranked 11 of 21. Corkbark fir was the most abundant (in numbers) seed in 2013, and was the 11th highest crop seen since 1993. Engelmann spruce was the second most abundant seed in 2013 and was the 14th highest crop seen since 1993. Douglas-fir was the least abundant seed in 2013, and was the 11th highest crop seen since 1993. The 2013 overall mean seed crop was 622.9 (1000 seeds/ha), smaller than the 2012 crop, 10216.5 (1000 seeds/ha), but larger than in 2011, 5.9 (1000 seeds/ha) (Table 3, Figures 2a-c, Appendix A).

***2014** Mushroom Production*

Overall annual mushroom production (sum of $\bar{x}$ wet weight for all areas) in 2014 was 337.6 kg/ha, slightly larger than in 2013 (268.8 kg/ha). The 2014 mushroom crop ranked 4th highest of 21 years since data collection began in 1994. Production increased in both TR and SF habitats in 2014 as compared to 2013 (Figure 3). In 2014, mushroom production ($\bar{x}$ wet weight) did not differ on study areas within each habitat or between habitats (Table 4). On TRC, three genera, *Clitocybe, Russula,* and *Cortinarius* accounted for 74% of production. On TRN, *Russula, Pholiota*, and *Cortinarius* accounted for 66% of total production. *Amanita, Russula,* and *Cortinarius* accounted for 74% of the production on SFC. On SFN, *Lactarius, Russula,* and *Amanita* accounted for 64% of the total production (Table 5).

Population Biology

Midden Occupancy

Four quarterly censuses (Mar, Jun, Sep, Dec) of all middens on or near monitored areas were conducted in 2014 (Appendix B). From December 2013 to December 2014, the number of red squirrels increased, from 53 to 58. On TRC, the highest number of squirrels (27 adults/subadults) was in September 2014, and the lowest number was 20 adults in December. The highest numbers on TRN were in September and December (16 adults) and the lowest was 13 adults in March. The highest number of squirrels on SFC was in September and December (9 adults) and the lowest was 5 adults in March. On SFN, the highest number (13 adults) was in December and the lowest was 2 adults in June (Figure 4, Appendix B, C, D). The total number of squirrels on the monitored areas in September 2014 (59: 53 adults + 6 juveniles) was the highest found since June 2002 (61: 34 adults + 27 juveniles) (Figure 5). On all areas in both TR and SF habitats, the number of squirrels increased throughout the year (Figure 5).

In 2014, three new middens were located in TR habitat and one midden that was previously removed from regular censusing due to historically low occupancy became reoccupied. In SF habitat one new midden was located and 2 previously removed middens became reoccupied (Appendix B). In June of 2014, the proportion of middens occupied did not differ within TR and SF habitats. However, in December 2014, there was a greater proportion of middens occupied on SFN than SFC (Table 6).

Overwinter Survival

The number of squirrels that survived the winter of 2013-2014 did not differ among areas (Table 7); survival was 56.8% (25 of 44 squirrels surviving) in TR habitat and 55.6% (5 of 9 squirrels surviving) in SF habitat. For comparison, survival from the previous winter, 2012-2013, was 65.2% (15 of 23 squirrels surviving) in TR habitat and 50% (10 of 20 squirrels surviving) in SF habitat. There were 13 marked squirrels on the monitored areas in December 2013, and by June 2014, 9 were known alive, 1 confirmed mortality (likely avian predation), 2 unconfirmed mortalities (collar only found, animal not seen after), and 1 animal disappeared, fate unknown.

Overwinter survival may be overestimated because a midden may be occupied in the spring by a different squirrel of the same sex. Such a change in occupancy can not be detected among unmarked squirrels. However, this potential overestimate is minimal in recent years as many squirrels on the monitored areas are ear-tagged and radio collared for unique identification.

Reproductive Activity and Success

In 2014, no breeding chases were observed on the monitored areas, however, 3 chases were seen on nearby study areas indicating breeding activity from at least mid March through early June (Appendix E-1). Based on information from census and trapping records, most resident adult males had testes fully scrotal March through June.

From May through September, several females seen or trapped during these months were found to be either pregnant or lactating. The first lactating females were observed the third week May and the latest was observed on 8 September. Direct evidence of 13 litters (31 juveniles emerged from natal nests) was documented on or near the areas during censuses or other activities. Litters were confirmed from mid June through early September (Appendix E-2).

Trapping and Marking

In 2014, 19 squirrels (8 male, 11 female), on or near monitored areas, had colored ear tags and radio-collars (Appendix B). These animals were located several times each month using radio telemetry to track home ranges, reproduction and survival.

Mapping

No significant changes in maps of the monitored areas were made in 2014, 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 from March - December 2014 (equipment failure in January and February) from the Biology Camp weather station (TR habitat). From available data, maximum temperature recorded was 24.7 °C in July and the minimum temperature recorded was -16.4 °C in December. The maximum average monthly temperature was 14.8 °C in June and the minimum average monthly temperature was 2.4 °C in December (Appendix F-1). The maximum total monthly rainfall was recorded in August, at 114.8 mm, however the rain gauge malfunctioned in July when there was considerable rainfall as well (Appendix F-1). Snow depth was recorded from nine pairs of snow poles. The average ***accumulated*** snow depth from November 2013 - April 2014 ranged from 0.0 cm to 42.0 cm (Appendix F-2). For comparison, average accumulated snow depths for the previous winter (December 2012 - April 2013), ranged from 0.0 cm to 78.0 cm. Data on

wind chill temperatures, wind direction and speed, humidity, and barometric pressure were also collected (Appendix F-1). Weather data are also collected near the monitored areas in the TR habitat from a Remote Automatic Weather Station (RAWS), located at Columbine Ranger Station. Weather data and reports can be found at: http://www.raws.dri.edu/cgi-bin/rawMAIN.pl?azACOL

Insect Outbreaks on Monitored Areas

Based on information from USFS Forest Health websites (see below), activity of bark beetles (*Dryocoetes confusus*, *Dendroctonus rufipennis, D. pseudotsugae*, and *D. brevicomis*) in Graham County was minimal in 2014. For detailed information on forest health and continuing research on insect infestations, please contact the USFS Southwestern Region Entomology and Pathology Office in Flagstaff, AZ.
http://www.fs.usda.gov/main/r3/forest-grasslandhealth
and
http://foresthealth.fs.usda.gov/portal

RECENT PUBLICATIONS

Peer-reviewed Journal Articles

2014

Ramos-Lara, N., J.L. Koprowski. 2014. Deforestation and knowledge gaps threaten conservation of less charismatic species: status of the arboreal squirrels of Mexico. Mammalia. 78:417-427.

2015

Doumas, S., J.L. Koprowski, W.O. Noble. 2015. Landscape-level assessment of Abert's squirrel and red squirrel in mixed conifer forest. Southwestern Naturalist, In press.

Posthumus, E.E., J.L. Koprowski, R.S. Steidl. 2015. Red squirrel middens influence abundance but not diversity of other vertebrates. PLoS ONE, In press.

Ramos-Lara, N., J.L. Koprowski. 2015. Spacing behavior of a non-larder-hoarding Tamiasciurus: A study of Mearns's squirrels in xeric coniferous forests. Ethology. 121:196-205.

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Table 1. Changes in size of study areas due to construction and fire events, University of Arizona Red Squirrel Monitoring Program, Pinaleño Mountains, Graham County, Arizona. All area measures are in hectares.

	Transition habitat		Spruce-fir habitat		
Event and Date	Construction [1]	Non-construction	Construction	Non-construction	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

1 Construction areas are ≤ 300 m from Mt. Graham International Observatory or access road. Non-construction areas are sites outside this boundary established for comparison.

Table 2. Mushroom genera known to be food resources of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), collected from the food resource plots on University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

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

Table 3. Mean *filled* conifer seed production, **2013**, on University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. The percent column represents the proportion of each seed species on an individual area (proportions add across rows).

		Corkbark fir		Douglas-fir		Engelmann spruce	
Area/Habitat	# plots	$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%	$\bar{x}$ 1000 seeds/ha	%
TRC	5	127.8	60.8	71.9	34.2	7.9	3.8
TRN	4	69.9	56.8	26.6	21.6	26.6	21.6
SFC	5	53.3	48.8	0.0	0.0	55.9	51.2
SFN	6	19.9	10.9	24.3	13.3	138.8	75.9
TR Habitat	9	102.1	59.5	51.8	30.2	16.2	9.5
SF Habitat	11	35.1	23.5	13.3	9.9	101.1	67.6

Table 4. Mean annual mushroom production, **2014**, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

Area/Habitat	n	$\bar{x}$ wet weight ± SE (kg/ha)	$\bar{x}$ dry weight ± SE (kg/ha)
TRC	5	65.6 ± 11.4	7.9 ± 1.9
TRN	4	110.0 ± 26.9	11.1 ± 2.8
SFC	5	76.7 ± 9.8	7.8 ± 0.9
SFN	6	85.4 ± 28.4	8.2 ± 2.6
TR Habitat	9	85.3 ± 14.8	9.3 ± 1.6
SF Habitat	11	81.5 ± 15.5	8.0 ± 1.4

Wilcoxon test within TR:

Wet Weight	$Z = 1.34$	P = 0.18
Dry Weight	$Z = 1.10$	P = 0.27

Wilcoxon test within SF:

Wet Weight	$Z = 0.82$	P = 0.41
Dry Weight	$Z = 0.82$	P = 0.41

Wilcoxon test between TR and SF:

Wet Weight	$Z = 0.61$	P = 0.54
Dry Weight	$Z = 0.84$	P = 0.40

Table 5. Mean annual mushroom production (wet weight kg/ha), 2014, of selected mushroom genera known to be food resources for red squirrels (*Tamiasciurus hudsonicus grahamensis*), University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. The percentages of the three most available genera on each area are in red (proportions add down columns).

	TRC		TRN		SFC		SFN	
Genus	$\bar{x}$ kg/ha	%	$\bar{x}$ kg/ha	%	$\bar{x}$ kg/ha	%	$\bar{x}$ kg/ha	%
Amanita	6.51	9.9	5.78	5.3	28.84	37.6	11.98	14.0
Auricularia	1.58	2.4	1.24	1.1	1.32	1.7	0.77	0.9
Boletus	0.00	0.0	0.00	0.0	4.75	6.2	0.00	0.0
Clavaria	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Clitocybe	20.19	30.8	5.88	5.4	2.79	3.6	1.86	2.2
Cortinarius	10.45	15.9	17.40	15.8	12.98	16.9	11.96	14.0
Gastroid sp.	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Hydnum	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Lactarius	5.86	8.9	15.87	14.4	3.38	4.4	25.39	29.7
Leccinum	0.00	0.0	0.00	0.0	1.64	2.1	5.21	6.1
Lycoperdon	2.17	3.3	2.64	2.4	5.42	7.1	2.15	2.5
Pholiota	0.00	0.0	26.84	24.4	0.00	0.0	0.00	0.0
Ramaria	0.95	1.4	4.51	4.1	0.50	0.7	0.91	1.1
Russula	17.86	27.2	28.66	26.1	14.79	19.3	17.37	20.3
Suillus	0.00	0.0	1.14	1.0	0.33	0.4	7.80	9.1
Total	65.56		109.98		76.74		85.40	

Table 6. Number and percent of available middens occupied by Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

	June			December		
Area/Habitat	# middens	# occupied	% occ	# middens	# occupied	% occ
TRC	52	19	36.5	55	20	36.4
TRN	36	14	38.9	38	16	42.1
SFC	30	7	23.3	30	9	30.0
SFN	19	2	10.5	22	13	59.1
TR Habitat	88	33	37.5	93	36	38.7
SF Habitat	49	9	18.4	52	22	42.3
TR + SF	137	42	30.1	145	58	40.0

Comparison of midden occupancy within habitats on RSMP study areas, June and December 2014.

JUNE *(Chi Square)*			
within TR	$\chi^2 = 0.05$	df = 1	P = 0.823
within SF *(Fisher's exact test*)*			P = 0.451
DECEMBER *(Chi Square)*			
within TR	$\chi^2 = 0.312$	df = 1	P = 0.576
within SF	$\chi^2 = 4.401$	df = 1	**P = 0.036**

* Used due to small sample sizes for June within SF habitat.

Table 7. Overwinter survival of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), 2013 - 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

	Number of Squirrels	Number of Squirrels Surviving	
Area/Habitat	Dec 2013[1]	Jun 2014	% Survival
TRC	27	16	59.3
TRN	17	9	52.9
SFC	6	3	50.0
SFN	3	2	66.7
TR Habitat	44	25	56.8
SF Habitat	9	5	55.6

*Fisher's exact test**	
within TR	P > 0.999
within SF	P > 0.999
between habitats	P = 0.753

* Used due to small sample sizes.

[1] Of the 53 animals resident on the areas in Dec 2013, 13 were radio collared and/or ear-tagged thus enabling unique identification. By Jun 2014, 9 of these animals were alive, 2 were unconfirmed dead (collar only found, animal not seen thereafter), 1 was confirmed dead (remains found) and 1 had disappeared, fate unknown. The number of marked animals in the population increases the accuracy of survival calculations.

Figure 1. Map of study areas, December 2014, University of Arizona Red Squirrel Monitoring Program, Pinaleño Mountains, Graham County, Arizona.

(1 map removed)

Figure 2a. Corkbark fir (*Abies lasiocarpa* var. *arizonica*) seed fall, 1993 - 2013, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. **Scales are different for figures 2a-c**.

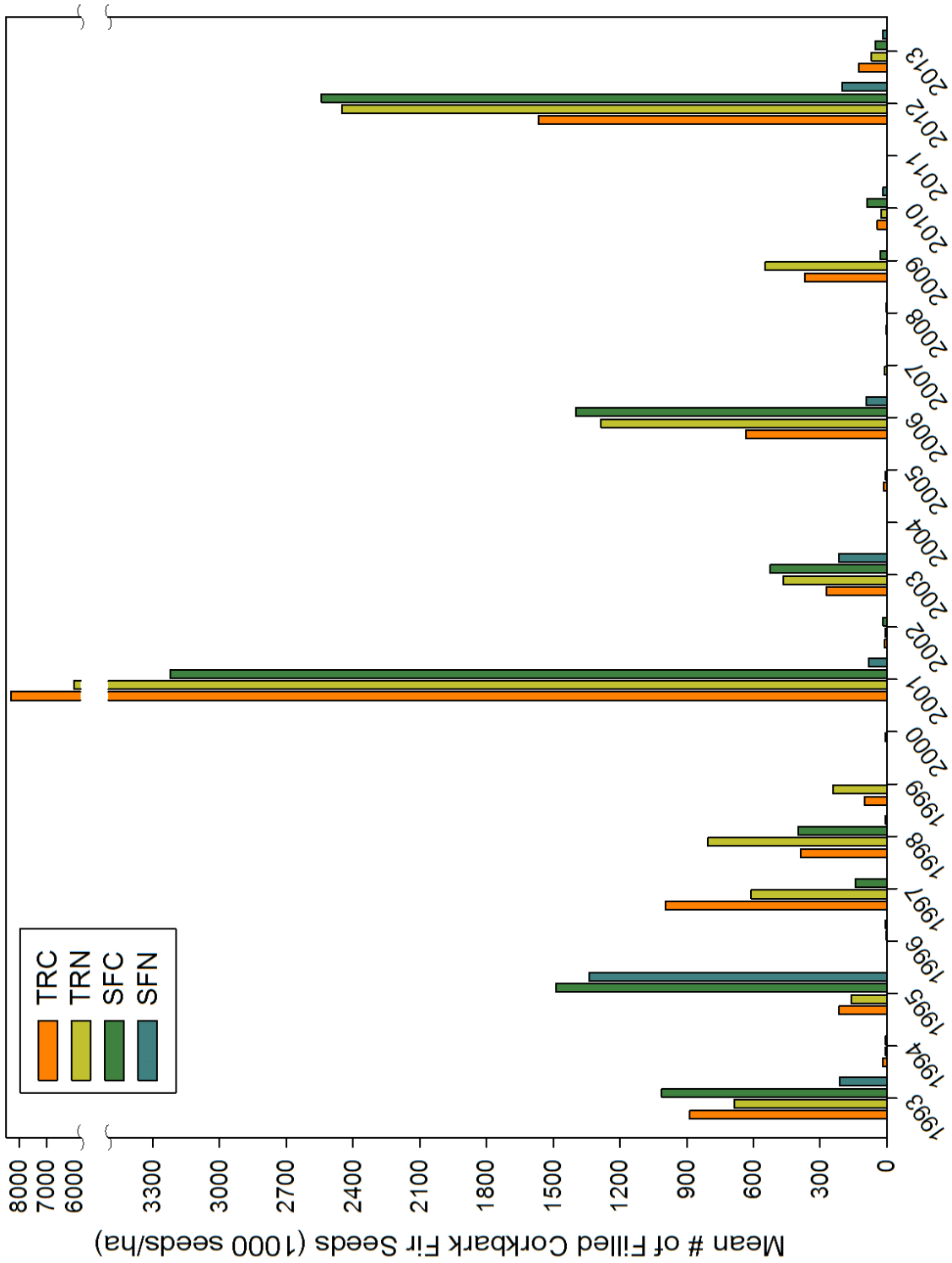


Figure 2b. Douglas-fir (*Pseudotsuga menziesii*) seed fall, 1993 - 2013, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. **Scales are different for figures 2a-c.**

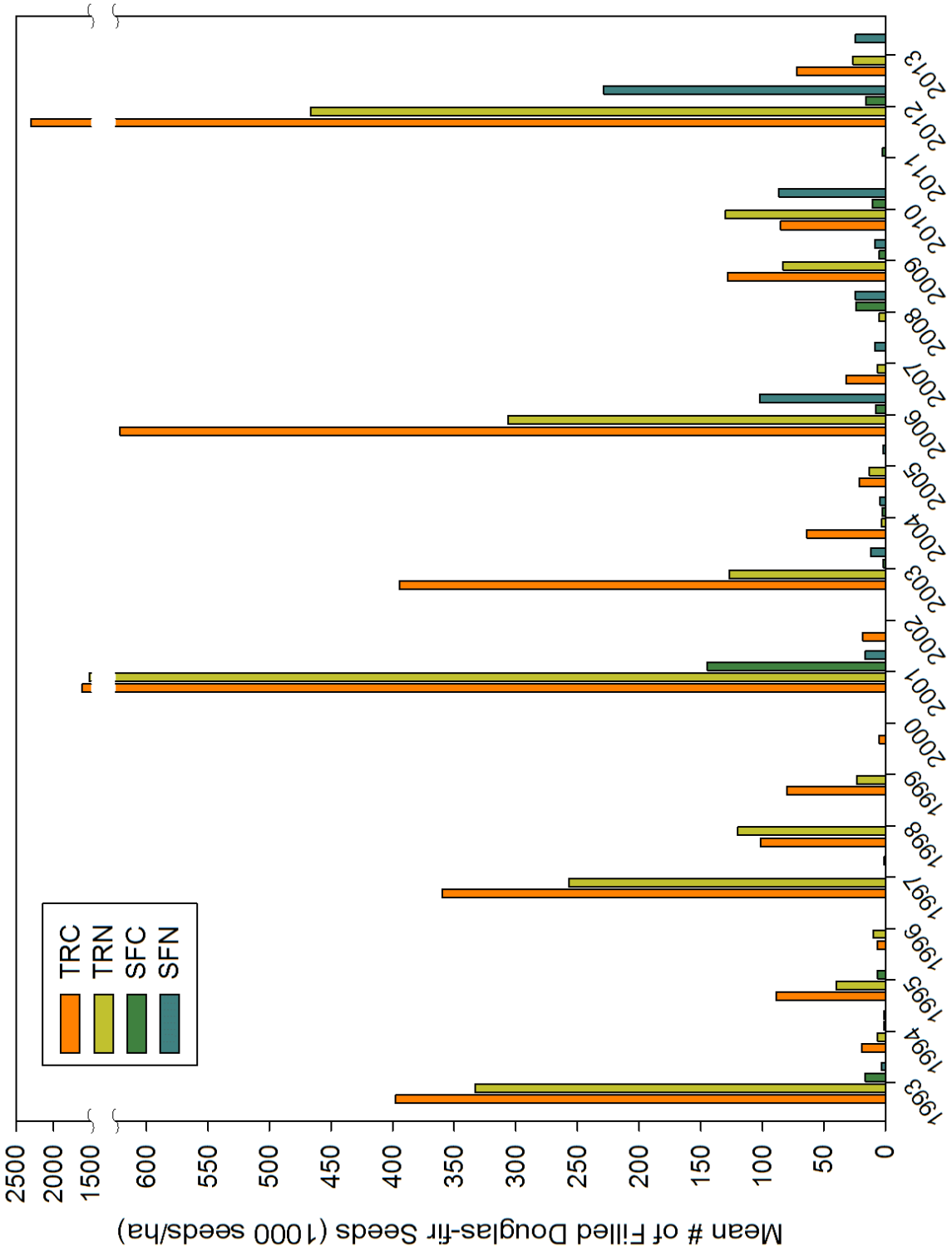


Figure 2c. Engelmann spruce (*Picea engelmannii*) seed fall, 1993 - 2013, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. **Scales are different for figures 2a-c.**

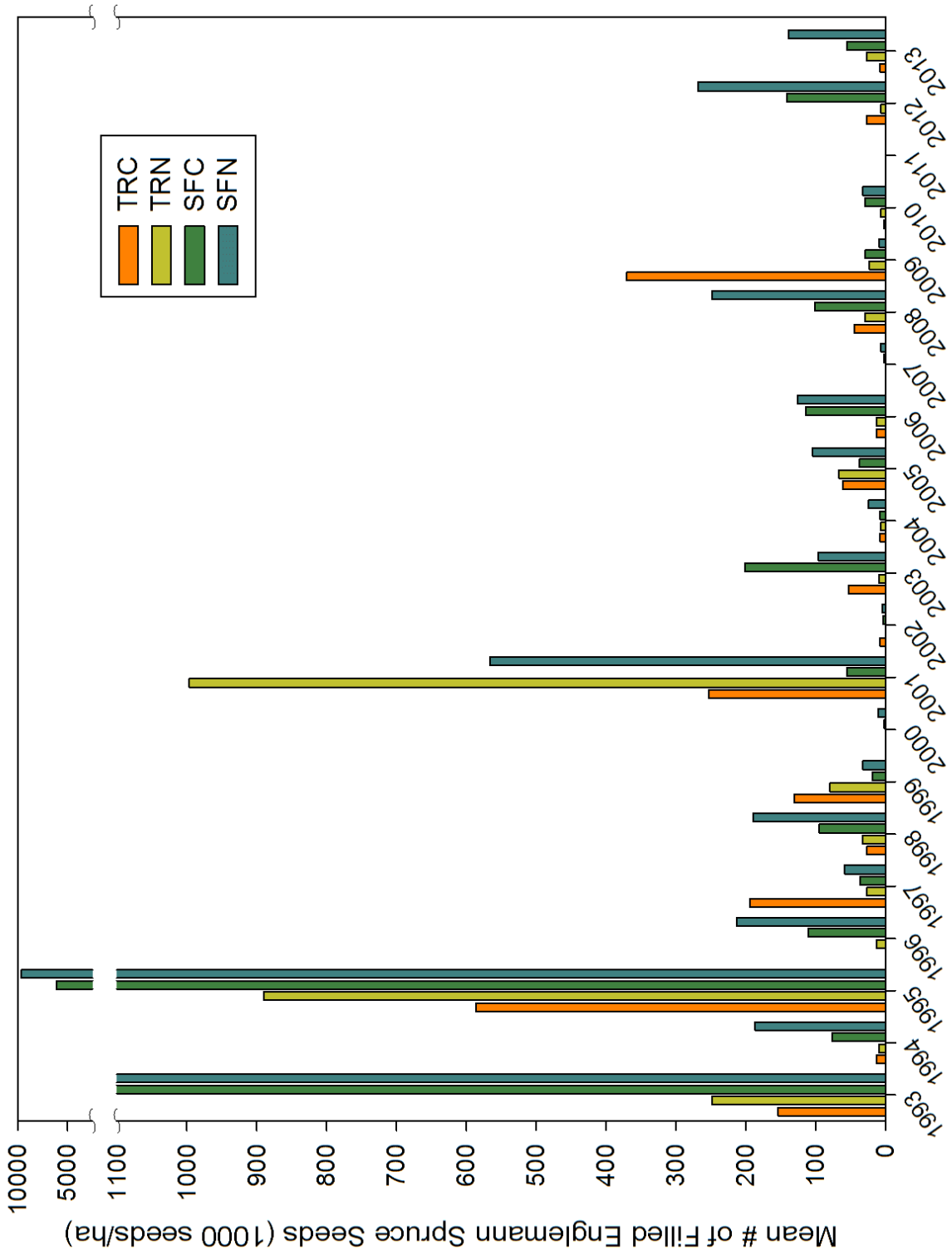


Figure 3. Mushroom crops by habitat, 1994 - 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

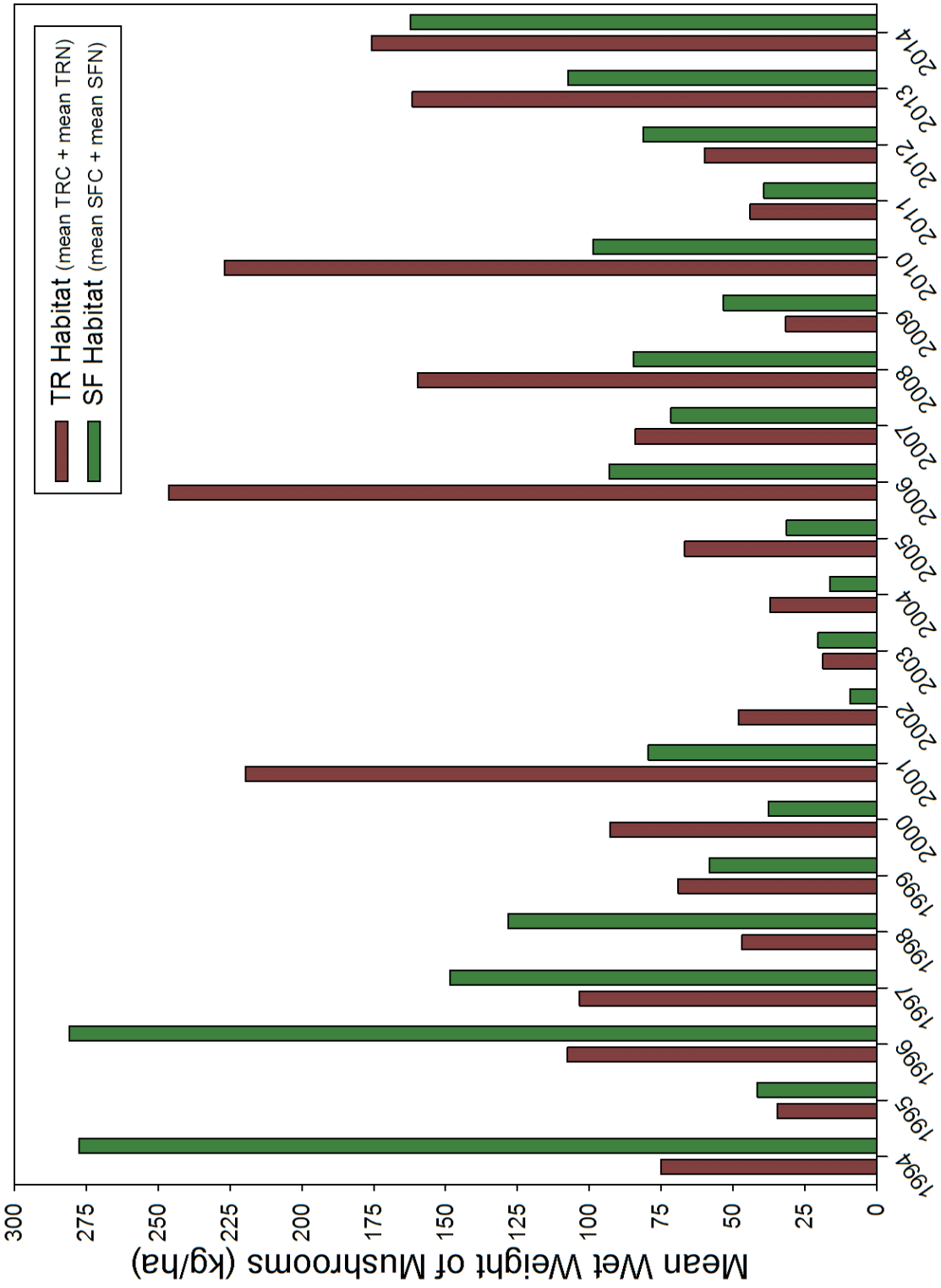


Figure 4. Quarterly Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) populations (including juveniles), April 2010* - December 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. (*first quarterly census in 2010 was delayed due to extreme snow conditions)

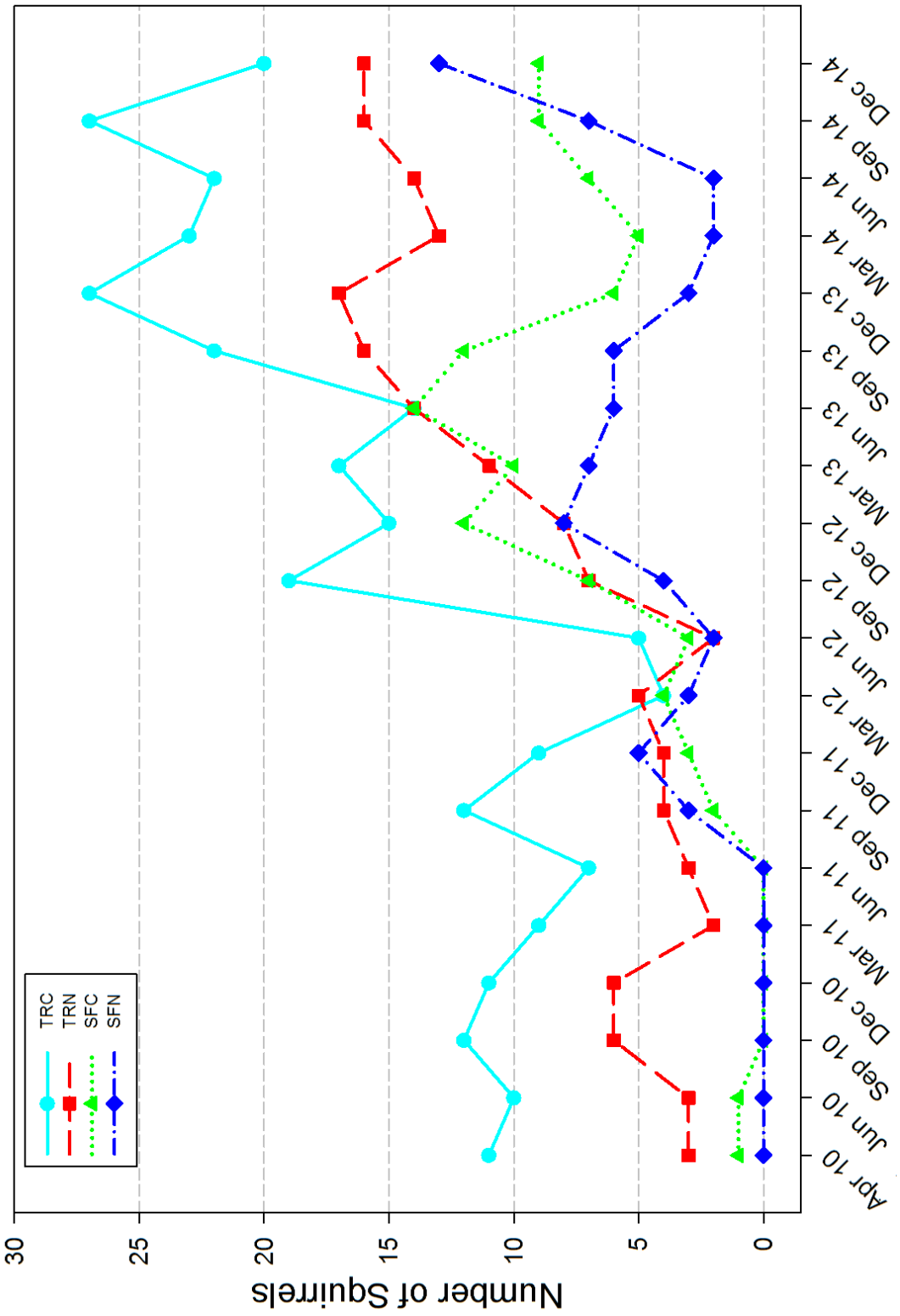
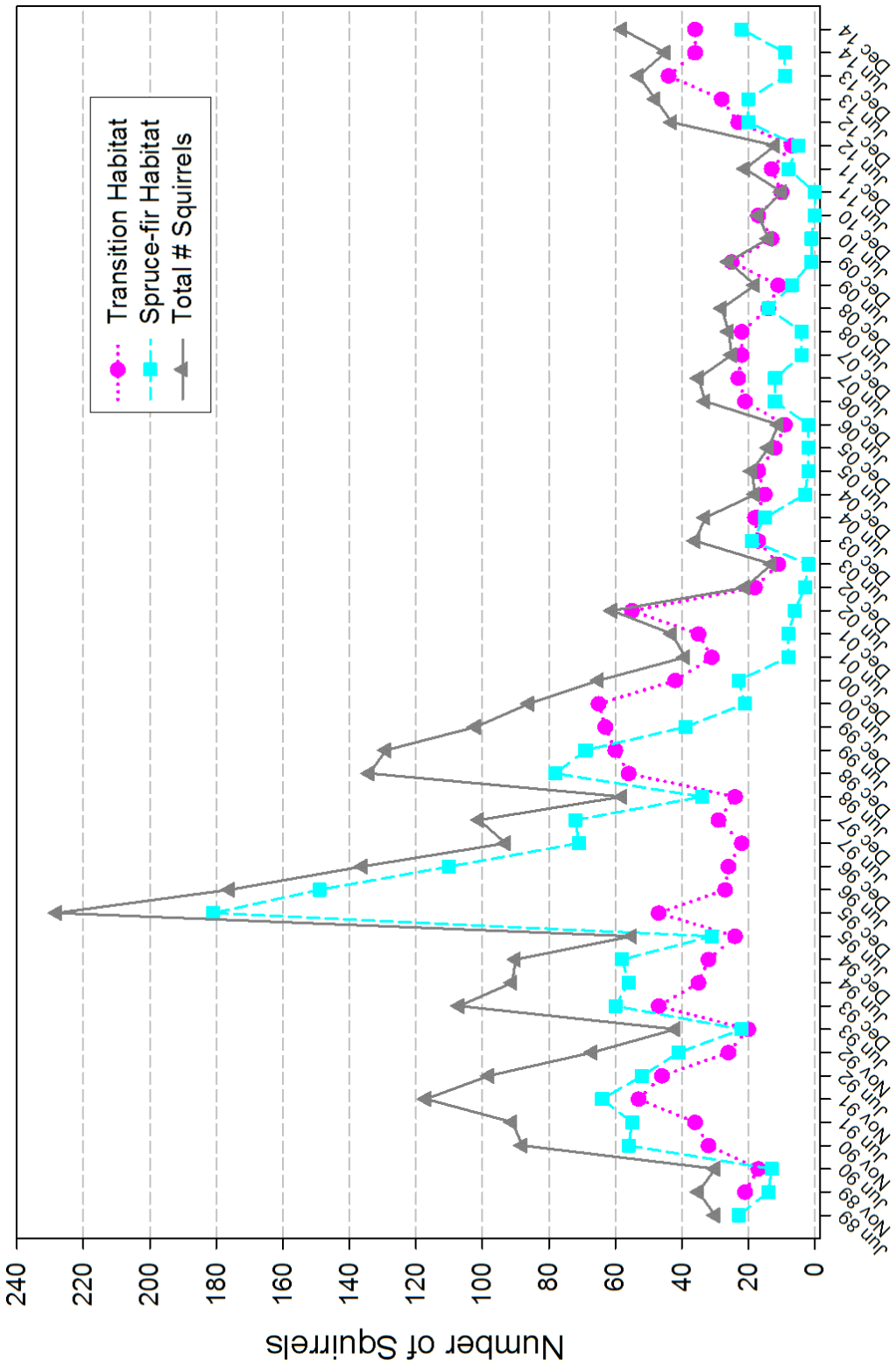


Figure 5. Summer and winter Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) populations (including juveniles), by habitat, June 1989 - December 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.



Appendix A. Mean number of seeds (filled) for **2013** and mushrooms (wet weight and dry weight) for **2013**, by area and habitat on University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

		Corkbark Fir	Douglas-fir	Englemann Spruce	Total Seeds	Total Mushrooms	
AREA	N	$\bar{x}$ 1000 seeds/ha	$\bar{x}$ 1000 seeds/ha	$\bar{x}$ 1000 seeds/ha	$\bar{x}$ 1000 seeds/ha	$\bar{x}$ ww kg/ha	$\bar{x}$ dw kg/ha
TRC	5	127.8	71.9	7.9	207.6	41.0	4.6
TRN	4	69.9	26.6	26.6	123.1	120.5	13.3
SFC	5	53.3	0.0	55.9	109.2	51.6	5.3
SFN	6	19.9	24.3	138.8	183.0	55.7	5.6
TR	9	102.1	51.8	16.2	170.1	76.3	8.5
SF	11	35.1	13.3	101.1	149.5	53.8	5.5

Appendix B: Midden occupancy records, 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

KEY

For Midden Numbers:

###^{89*}	Midden Number$^{\text{'Year Found'}}$ '*' 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, subadult red squirrel
♀ (R/R RC 101)	squirrel is tagged (letters indicate ear tag colors - left ear/right ear, numbers indicate RSMP animal ID) [B = blue, G = green, M = metal, O = orange, P = pink, R = red, Y = yellow, W = white n = none, -- = rip] [RC = radio collar] [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

Note: Beginning with the 2009 Annual Report, middens that have been removed from regular censusing due to permanent fire damage or low occupancy, are no longer listed in Appendix B. Please refer to the 2008 Annual Report for a complete list of these middens.

Transition Construction Area (TRC), 2014				
Midden	Mar	Jun	Sep	Dec
1102[89]	S	Y	Y	♂
1103[89]	S	S	S	S
1104[89]	S	♀	♂	S
1111[89]	N	N	N	N
1112[89*]	N	N	N	N
1113[89]	♂	P	N	N
1115[89]	N	N	N	N
1116[89]	N	N	S	N
1118[89]	♂ (Wsq/Rsq RC 1036)	♂ (Wsq/Rsq RC 1036)	♂ (Wsq/Rsq RC 1036)	P
1121[89*]	N	N	S	Y
1127[14*]	New midden		♂	S
1131[90*]	♂ (O/W RC 1096)	♂ (O/W RC 1096)	♂ (O/W RC 1096)	♂ (O/W RC 1096)
1134[91*]	S	♀	N	P
1144[91*]	N	N	N	N
1147[91*]	Y	Y	♀	N
1149[91*]	N	N	N	N
1151[91*]	P	N	P	N
1153[92*]	♀ (W/O RC 1130)	♀ (W/O RC 1130)	♀ (W/O RC 1130) + 1J	♀ (W/O RC 1130)
1154[92*]	♂ (Y/O RC 1143)	Y	♀ + 1J	♀ (W/W RC 1162)
1156[93*]	♂ (Bsq/Ysq RC 1100)	♂ (Bsq/Ysq RC 1100)	♂ (Bsq/Ysq RC 1100)	♂ (Bsq/Ysq RC 1100)
1160[96*]	♂ (O/G 1144)	♂	P	N
1162[96*]	N	N	N	N
1163[98*]	♀ (B/Y RC 958)	♀ (B/Y RC 958)	P	N
1164[98*]	♀ (Gsq/Wsq RC 1071)	♀ (Gsq/Wsq RC 1071)	P	♂ (Wsq/Rsq RC 1036)
1167[98*]	♀ (R/B RC 1010)	♀ (R/B RC 1010)	2J [2]	♀
1168[98*]	N	N	N	N
1169[98*]	N	N	N	P
1170[98*]	♀	♂	♂	♂
1171[98*]	N	N	N	N
1172[90*]	N	N	N	N
1173[99*]	N	N	N	N
1174[99*]	N	N	♂	S
1175[99*]	♂	P	N	N

Transition Construction Area (TRC), 2014				
Midden	Mar	Jun	Sep	Dec
1176[99*]	re-occupied [1]		S	♀ (Y/B RC 1159)
1177[99*]	P	N	N	N
1179[99*]	N	N	N	N
1180[99*]	N	N	N	N
1182[02*]	N	N	N	N
1183[04*]	N	N	N	N
1184[04*]	Y	N	N	S
1185[05*]	N	N	N	N
1186[05*]	N	N	N	N
1187[05*]	N	N	N	N
1188[10*]	N	N	N	N
1189[10*]	Y	♀ + 3J	P	S
1190[10*]	N	P	N	N
1191[10*]	N	N	N	N
1192[11*]	P	N	S	♀
1193[12*]	S	Y	♀	♀ (G/G RC 1160)
1194[13*]	♂	♂	♀ + 2J	N
1195[13*]	S	Y	N	N
1196[13*]	N	N	Y	N
1197[13*]	P	P	Y	N
1198[13*]	Y	N	S	S
1199[14*]	new midden			♀
# Mid	52	52	54	55
# Occ	23	19	22	20
% Occ	44%	37%	41%	36%
# Sq	23Ad	19Ad + 3Juv	21Ad + 6Juv [2]	20

1 Midden was previously removed from regular censusing due to low occupancy. Was discovered to be reoccupied and is now added back to regular censusing.

2 The two older juveniles at midden 1167 shift appeared to be residing together in the midden, after the collar of their mother, ♀1010, was found in September. These two juveniles are counted with the juveniles still living at mother's middens.

Transition Non-Construction Area (TRN), 2014				
Midden	Mar	Jun	Sep	Dec
2202[89]	♂	S	N	N
2203[89]	♀ (Rsq/Rsq 1124)	♀ (Rsq/Rsq 1124)	S	S
2204[89]	N	N	N	N
2205[89]	N	N	Y	N
2206[89]	S	Y	S	♂
2208[89*]	N	♂	♀	S
2210[90]	N	N	N	N
2211[90*]	♀ (Rsq/Bsq RC 1035)	P	Y	♂
2215[90*]	N	N	N	N
2216[90*]	N	♀	S	♂
2217[90*]	N	N	N	N
2218[91*]	Y	♀	♀	S
2219[91*]	N	N	S	♂
2223[91*]	S	N	N	N
2227[95*]	N	N	N	N
2229[96*]	S	Y	P	N
2230[96*]	N	N	N	N
2234[97*]	N	N	N	N
2235[98*]	N	N	N	N
2236[98*]	♂ (Bsq/Osq 1122)	♂ (Bsq/Osq 1122)	S	S
2237[98*]	N	N	N	N
2238[98]	S	♀	♀	♀
2239[98]	N	Y	S	S
2240[98]	N	P	♀	N
2241[98*]	N	N	N	N
2242[98*]	N	N	N	N
2244[99*]	Y	♀	Y	♀
2246[99*]	N	N	N	N
2248[99*]	N	N	N	N
2249[99*]	N	N	N	N
2250[00*]	N	N	N	N
2252 [08*]	♂	♂	S	♂
2253 [09*]	♀	S	S	S
2255 [11*]	N	N	N	P

Transition Non-Construction Area (TRN), 2014				
Midden	Mar	Jun	Sep	Dec
2256 [12*]	Y	♂	♂	♀
2257 [13*]	N	N	N	P
2258 [14*]	new midden			♂
2260 [14*]	new midden			S
# Mid	36	36	36	38
# Occ	13	14	16	16
% Occ	36%	39%	44%	42%
# Sq	13	14	16	16

Spruce-Fir Construction Area (SFC), 2014				
Midden	Mar	Jun	Sep	Dec
3002[95*]	Y	Y	♀	Y
3020[96*]	N	P	N	N
3022[96*]	N	N	N	S
3028[99*]	N	N	N	N
3033[12*]	N	N	N	N
3034[12*]	Y	S	♀	♀
3035[13*]	N	N	P	N
3036[13*]	P	N	N	N
3303[94*]	N	N	N	N
3310[95*]	S	♂	♂	♂
3311[95*]	P	Y	S	P
3312[95*]	N	P	N	N
3314[95*]	N	N	N	N
3323[95*]	N	♀	N	♂
3328[95*]	N	N	N	N
3330[95*]	N	N	N	N
3341[95*]	N	N	N	N
3346[95*]	Y	N	S	S
3348[95*]	N	N	S	♀
3360[86]	S	P	S	P
3362[86]	N	N	P	Y
3365[86]	N	N	N	N
3366[86]	N	Y	Y	N
3370[86]	N	Y	N	N
3371[87]	N	N	N	N
3372[89]	N	N	N	N
3374[89]	N	N	N	Y
3378[90*]	N	N	S	N
3382[91*]	N	N	N	N
3394[93*]	N	N	N	N
# Mid	30	30	30	30
# Occ	5	7	9	9
% Occ	17%	23%	30%	30%
# Sq	5	7	9	9

Spruce-Fir Non Construction Area (SFN), 2014				
Midden	Mar	Jun	Sep	Dec
4000[95*]	N	N	P	N
4010[95*]	N	N	P	N
4023[98*]	re-occupied [1]			♂
4026[09*]	N	N	Y	S
4027[12*]	N	N	♀	S
4028[14*]	new midden			S
4400[89]	N	N	N	N
4417[95*]	N	N	N	Y
4465[90*]	N	P	N	S
4466[87]	N	N	N	S
4467[87]	N	P	N	S
4469[87]	N	N	P	S
4470[87]	N	N	N	N
4471[87]	N	P	S	S
4472[87]	N	N	N	N
4473[87]	N	N	N	N
4474[86]	N	N	N	N
4477[87]	N	N	N	N
4484[86]	S	Y	Y	♂
4488 [91*]	N	N	Y	♂
4491[91*]	S	Y	S	♂
4492[91*]	re-occupied [1]		S	P
# Mid	19	19	20	22
# Occ	2	2	7	13
% Occ	11%	11%	35%	59%
# Sq	2	2	7	13

1 Midden was previously removed from regular censusing due to low occupancy. Was discovered to be reoccupied and is now added back to regular censusing.

Off-Area Midden Occupancy, 2014				
Midden	Mar	Jun	Sep	Dec
TRC Area				
5101[89]	S	♂	♂	♂
5102[98*]	♂	♂	N	Y
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
5118[94*]	N	N	N	N
5119[89*]	Y	♀	♂	♂ (Psq/Gsq RC 1158)
5121[89*]	Y	♀	S	♂
5125[89*]	N	N	N	N
5126[91]	N	N	N	N
5145[91*]	P	N	N	N
5150[91*]	Y	♀	N	N
5155[93*]	♀ (Bsq/Rsq 1075)	♀ (Bsq/Rsq 1075)	♀ (Bsq/Rsq 1075)	N
5157[93*]	N	P	S	♀
5159[12]	♂ (met/Y RC 964)	♂ (met/Y RC 964)	♂ (met/Y RC 964)	♂ (Gsq/Osq RC 1161)
TRN Area				
5200[93*]	Y	♂	♂	♂
5201[99*]	N	N	N	N
5203[00*]	N	N	N	N
5221[91*]	N	N	S	S
5231[96*]	N	N	N	N
5232[96*]	N	N	N	N
SFC Area				
5311[95*]	N	N	N	N
5313[95*]	N	N	N	N
5350[86]	N	N	N	N
5361[96*]	N	N	N	N
5377[87]	N	N	S	N
SFN Area				
5405[87]	N	N	P	N
5413[95*]	N	N	N	N

Appendix C. Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) populations (including juveniles at maternal middens), April 2010 - December 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

Date	TRC	TRN	SFC	SFN	TOTAL
Apr 2010[1]	11	3	1	0	15
Jun 2010	10	3	1	0	14
Sep 2010	5 + 7 Juv	4 + 2 Juv	0	0	9 + 9 Juv
Dec 2010	11	6	0	0	17
Mar 2011	9	2	0	0	11
Jun 2011	7	3	0	0	10
Sep 2011	9 + 3 Juv	4	2	3	18 + 3 Juv
Dec 2011	9	4	3	5	21
Mar 2012	4	5	4	3	16
Jun 2012	5	2	3	2	12
Sep 2012	11 + 8 Juv	7	3 + 4 Juv	4	25 + 12 Juv
Dec 2012	15	8	12	8	43
Mar 2013	17	11	10	7	45
Jun 2013	14	10 + 4 Juv	14	6	44 + 4 Juv
Sep 2013	22	16	12	6	56
Dec 2013	27	17	6	3	53
Mar 2014	23	13	5	2	43
Jun 2014	19 + 3 Juv	14	7	2	42 + 3 Juv
Sep 2014	21 + 6 Juv	16	9	7	53 + 6 Juv
Dec 2014	20	16	9	13	58

1 The first census of 2010 was done in April instead of March due to extreme snow conditions.

Appendix D: Quarterly occupancy maps for Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), March, June, September, and December 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

(12 maps removed)

Appendix E: Reproductive success of Mt. Graham red squirrels (*Tamiasciurus hudsonicus grahamensis*), 2014 on or near [1] University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

E-1: Mt. Graham red squirrel breeding chases on or near the study areas.

E-2: Mt. Graham red squirrel litters seen on or near the study areas.

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1 Reproductive success notes for squirrels at middens ≥ 100 m from study area boundaries (numbered in 5000s and 8000s) are included for anecdotal information only. Litters at these middens are not counted in population totals for the Monitoring Program study areas.

Appendix E-1: Breeding Chases Observed - 2014

There were no breeding chases observed on the University of Arizona Red Squirrel Monitoring Program study areas in 2014, however information on breeding chases in other areas of the Pinaleño Mountains is included here to provide a general time frame for red squirrel breeding activity.

Date	Location	Notes
14 Mar 2014	midden 8001	At about 1700h, 5 unmarked squirrels were chasing and buzz calling in the midden area.
14 Mar 2014	midden 8072	At about 1500h, 1 unmarked female resident was being harassed by 1 scrotal male. Both animals were in a nest cavity, the female then chased the male out. The male was making buzz calls and stayed in the trees nearby.
2 Jun 2014	midden 8007	Mating chase activity around marked Female 1137, marked Male 1093 and two unmarked males were seen. Female 1137 could not be located for two days following this observation, but then she was seen back at 8007.

Appendix E-2: Litters observed in 2014 on or near University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona. Only litters on the monitored areas during census months are counted in the quarterly population totals (see Appendix C).

Mother ID	Midden/Nest	Date Litter 1st Seen	Notes
958	1163	1 Jul 14	1 juvenile
960	8060	1 Aug 14	3 juveniles
981	8051 shift	28 Jul 14	2 juveniles
1010	1167 shift	1 Aug 14	2 juveniles
1051	8043 shift	19 Jun 14	4 juveniles
1071	1164	8 Aug 14	1 juvenile
1103	8044 shift	20 Jun 14	4 juveniles
1104	8009	3 Aug 14	4 juveniles
1130	1153	27 Aug 14	1 juvenile confirmed, possibly a second
♀unmk	1189	16 Jun 14	3 juveniles
♀unmk	8072	19 Jun 14	3 juveniles
♀unmk	1194	7 Sep 14	2 juveniles
♀unmk	1154	7 Sep 14	1 juvenile
Total	13 litters		31 juveniles confirmed

Appendix F. Weather information, 2014, University of Arizona Red Squirrel Monitoring Program study areas, Pinaleño Mountains, Graham County, Arizona.

F-1: Monthly weather summaries*

F-2: Accumulated snow depths

*Due to various hardware and software problems, data is missing for the following periods in 2014:
January - February 2014, no data
late June - July, no rain data

Appendix F-1: Monthly weather summaries - 2014, Biology Camp.

Biology Camp Weather Summary

Date: Mar 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	-5.800	702.500	26.000	-18.400	0.000	0.000	-8.700	0.000
Avg	2.618	709.945	48.010	-7.815	0.581	2.155	2.339	
Max	9.200	714.800	96.000	0.300	2.200	8.050	9.200	0.000
Total								0.000
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South West

Date: Apr 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	-8.300	701.900	13.000	-19.200	0.000	0.000	-10.800	0.000
Avg	3.767	710.586	48.627	-7.320	0.743	2.736	3.338	
Max	15.200	718.700	100.000	4.300	2.200	8.050	15.200	0.000
Total								0.000
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: West

Date: May 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	-4.800	703.400	15.000	-15.400	0.000	0.000	-4.800	0.000
Avg	8.192	713.531	43.780	-4.410	0.366	1.385	8.152	
Max	22.200	719.300	99.000	6.600	1.300	4.830	22.200	0.000
Total								0.000
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: West

Date: Jun 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	7.100	712.800	14.000	-10.700	0.000	0.000	7.100	0.000
Avg	14.828	716.168	43.293	1.350	0.057	0.229	14.828	
Max	23.900	719.400	91.000	10.900	0.900	3.220	23.900	0.000
Total								0.000
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: North

West South West

Appendix F-1 (cont.):

Biology Camp Weather Summary

Date: Jul 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	7.400	716.000	33.000	-2.100	0.000	0.000	7.400	0.000
Avg	13.588	719.177	69.164	7.627	0.138	0.522	13.587	
Max	24.700	722.400	100.000	14.100	1.800	6.440	24.700	0.800
Total								1.800
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South East

Date: Aug 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	5.800	713.100	35.000	1.500	0.000	0.000	5.800	0.000
Avg	11.661	717.140	59.419	5.716	0.138	0.530	11.661	
Max	19.800	719.800	80.000	10.000	1.300	4.830	19.800	21.400
Total								114.800
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South East

Date: Sep 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	4.200	708.700	29.000	-11.900	0.000	0.000	4.200	0.000
Avg	10.941	714.524	87.935	8.720	0.135	0.514	10.941	
Max	20.200	717.900	100.000	14.300	0.900	3.220	20.200	6.000
Total								68.200
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South East

Date: Oct 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	0.500	708.600	13.000	-18.000	0.000	0.000	0.500	0.000
Avg	7.891	713.391	64.791	0.824	0.228	0.853	7.870	
Max	16.300	718.600	100.000	8.700	2.200	8.050	16.300	10.200
Total								61.400
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South East

Appendix F-1 (cont.):

Biology Camp Weather Summary

Date: Nov 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	-7.600	705.400	9.000	-32.800	0.000	0.000	-11.700	0.000
Avg	2.353	711.446	51.321	-8.528	0.539	2.004	1.973	
Max	12.800	719.700	100.000	5.700	3.100	11.270	12.800	3.200
Total								12.000
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: South East

Date: Dec 2014

Recording Interval: 60min

	Outside Temperature	Barometric Pressure	Relative Humidity	Dew Point	Wind Speed	Max Wind Speed	Wind Chill	Rain
Min	-16.400	697.700	10.000	-27.500	0.000	0.000	-16.400	0.000
Avg	-0.717	709.425	64.829	-7.913	0.435	1.616	-1.116	
Max	8.800	716.200	100.000	5.900	2.200	8.050	8.800	6.200
Total								30.200
	C	millibars	%	C	meters/sec	meters/sec	C	millimeters

Predominant Wind Direction: West

F-2: ***Accumulated*** snow depths on the monitored areas for Winter 2013 - 2014.

Snow Depth Summary

Snow Year Year	*Month*	*Habitat*	*Location*	*Avg Depth (cm)*	*Min Depth (cm)*	*Max Depth (cm)*	*Avg. % Cover*	*# of Readings for Avg.*
2013-2014								
2013	Nov	Transition	Clearing	10.3	8	15	100.0	3
2013	Nov	Transition	Forest	16.0	10	22	100.0	2
2013	Dec	Spruce-fir	Clearing	34.0	31	37	97.3	3
2013	Dec	Spruce-fir	Forest	16.0	11	21	100.0	2
2013	Dec	Transition	Clearing	13.9	5	20.5	98.7	6
2013	Dec	Transition	Forest	21.3	14	29	100.0	4
2014	Jan	Transition	Clearing	19.8	0	41	79.2	6
2014	Jan	Transition	Forest	26.5	12	40	83.8	4
2014	Feb	Transition	Clearing	15.4	0	33	62.2	9
2014	Feb	Transition	Forest	19.2	0	41	76.7	6
2014	Mar	Spruce-fir	Clearing	42.0	42	42	99.0	1
2014	Mar	Spruce-fir	Forest	33.0	33	33	100.0	1
2014	Mar	Transition	Clearing	31.3	0	49	89.8	6
2014	Mar	Transition	Forest	28.5	12	44	99.8	4
2014	Apr	Transition	Clearing	1.8	0	11	24.2	6
2014	Apr	Transition	Forest	0.0	0	0	11.3	4
		Averages for Snow Year		20.6	11.1	29.9	82.6	*Sum # Readings*
			Std Dev	11.55				67
			SE of Mean	1.41				