Abert's Squirrel Population Trend Monitoring Protocol
Pike and San Isabel National Forests

Introduction:
Abert's squirrels (*Sciurus aberti*) are designated as a management indicator species (MIS) for the Pike and San Isabel National Forests (PSI) within the ponderosa pine community. Abert's squirrels have been studied widely, and are well known for their dependence upon ponderosa pine (*Pinus ponderosa*) forests (e.g., Keith 1965, Ffolliott and Patton 1978, Hall 1981). While many aspects of Abert's squirrel biology are well documented, limited research has been conducted on reliable and cost-effective survey techniques. Dodd et al. (1998) is the most comprehensive such study completed to date, and was therefore chosen as the foundation for developing a monitoring protocol for the PSI. The combined spring feeding index method described by Dodd et al. (1998) was selected for use on the PSI. Minor modifications, additions, and commentary are provided to adapt the method for forest-wide monitoring purposes, and to provide a simple, step-by-step guide for biologists in the field. While the feeding index technique is not considered as rigorous as live trapping, the method was shown to be highly reliable by Dodd et al. (1998), yielding results very comparable to live trapping ($r^2 = 0.901$ when used in April). The technique is also much less expensive, requires minimal time and personnel, and has no adverse impact on the squirrels.

Applicability of Method in Colorado:
It is important to note that while the methodologies described in Dodd et al. (1998) were calibrated and validated by comparisons with live trapping of squirrels in Arizona, no such calibration of the technique has been done for Colorado. Habitat conditions and squirrel populations in Colorado differ from those in Arizona. Tree reproductive patterns are different and the trophic interactions between the squirrels and their primary food source, ponderosa pine, are different. Hence, the relationship between feeding sign and squirrel abundance may be different. For this reason the following protocol will be used only as an index of relative abundance, rather than as an index that may be transformed to an estimate of squirrel densities. From relative abundance estimates, population trends may be obtained meeting one of the primary requirements for MIS monitoring. If funds and personnel become available to calibrate the technique in Colorado through concurrent live trapping of squirrels, density estimates could be obtained from the data.

An important feature of Dodd et al.'s (1998) effort was a power analysis, which allowed them to determine the sampling effort necessary to obtain statistically rigorous results. While no similar analysis has been done using the technique in Colorado, it appears reasonable to use a similar sampling effort for the following reasons:

1. The combined feeing index includes all major types of foraging activity, reducing the likelihood that differences in forage availability associated with habitat differences would affect results.
2. Reported squirrel densities for Colorado of 0.12 – 1.14 squirrels/ha (Fitzgerald et al. 1994) are similar to the uncorrected densities of 0.02 – 1.0 squirrels/ha reported by Dodd et al. (1998). Uncorrected densities are used for this comparison since densities reported for Colorado are presumed to be uncorrected. If population densities are similar, and detectability of foraging activity is similar as described in point 1 above, sampling effort required to obtain meaningful results should also be similar.

Anecdotally, Abert's squirrel populations on the Pike National Forest appear to be lower than those on Dodd et al.'s (1998) study sites (pers. obs. Mike Elson). This could be a result of lower productivity of trees and fewer large diameter trees (and thus smaller cone crops), lower tree densities, lower productivity of hypogeous fungi, longer or more extreme winter conditions, or possibly fewer chemically suitable feed trees. Despite these potential differences, however, a preliminary use of the combined feeding index to monitor plots within the Upper South Platte Watershed Protection and Restoration Project in the summer of 2001 (Bogani 2001) yielded results comparable to those of Dodd et al. (1998). Approximately 10 – 16% of all 1m² plots sampled in September by Bogani (2001) contained evidence of squirrel foraging activity, while approximately 7-21% of all 1 m² plots sampled by Dodd et al. (1998) during August contained feeding evidence. These results suggest

sufficient similarity between Colorado and Arizona habitats and squirrel populations to use the techniques developed by Dodd et al. (1998), but further study is required.

Survey Protocol

1. Surveys should be conducted in the spring (March – May)

2. Survey plots should consist of a grid with parallel transects at least 70 m apart. Sampling locations along individual transects should be approximately 17.5 m apart, and there should be at least 256 sampling locations within each plot. Preferably, the grid will contain 8 transects of equal length to create a compact grid (square shape, approx. 60 ac in size – see figure 1). If habitat edges or topography prohibit a square, minor modifications can be made as long as the grid maintains a relatively compact shape (e.g., slightly more slender plot, see figure 2).

3. Sampling locations do not have to be permanently marked for future surveys, however the starting location for the first transect and the survey layout should be recorded to ensure the same plot is being surveyed in subsequent years.

4. At each of the 256 sampling locations a 1 m^2 frame is placed on the ground. Within the frame all fresh Abert's squirrel feeding evidence is counted. Place the frame directly in front of your foot when you reach the appropriate paced distance (do not bias the sample towards feeding evidence if visible). Fresh feeding evidence is defined as green (or mostly green) clipped needle clusters, white peeled twigs, red or orange cone cores, and fungi digs without litter or soil obscuring the hole. This will limit data collection to feeding evidence which is at most one year old (typically <6 months), and prevent double-counting in future surveys (there is no need to remove feeding evidence from the frame after it is counted).

5. Primary data analysis should be based on the percentage of sampling locations that contain fresh feeding evidence. For example, the comparison from one year to another would be a comparison of the percentage of subplots with feeding evidence present. Specific information on type and abundance of feeding evidence may be used to further refine the analysis (such as inferences about the primary season of use) or detect problems (e.g., observer error), but should be used carefully when determining population trends (see Dodd et al. 1998).

6. Each district should identify plots to be sampled annually. Plots should be located in ponderosa pine or ponderosa pine/Douglas-fir forests where the Douglas-fir component is less than 50% of the stand. To the extent possible, plot locations should be stratified by structural stage. Ideally, 2-5% of ponderosa pine structural stages 4A, 4B, 4C, and 5 will be monitored on each district. All suitable plots at least 60 acres in size should be identified, and then a suitable number of the potential plots should be randomly selected to represent 2-5% of the area of inference. Plots should not be placed adjacent to obvious habitat edges and should be at least 1 km (0.6 mi) apart to ensure independent samples. Once established, a plot will typically take about 4 hours for one person to survey each year.

PSICC – ABERT'S SQUIRREL MONITORING DATA FORM

Date: ___ __/__ __/__ __ __ __ Pg __ of ____

Transect #: ____ Plot ID Num: __ __ / __ __ / __ / __ 60 ac 30 ac Recorder(s): _____

Dist# Plot# Hab T

Dist=(District)-SAL- 02, PP- 09, SPK- 10, SPL- 11 **Hab**=(Habitat Quality)-High- 1, Med- 2, Low- 3, Non/Hab- 4 **T**=(Type)-Management-0, Control-1

GPS Start Coordinates: _____ X _____ GPS datum: _____

SUB PLOT NUMBER	# NEEDLE CLUSTERS	# PEELED TWIGS	# CONE CORES	# FUNGI DIGS	SIGN OUTSIDE?/ DISTANCE	REMARKS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
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22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						

GPS End Transect Coordinates: _____ X _____ GPS datum: _____

PSICC – ABERT'S SQUIRREL MONITORING DATA FORM

Date: ___ __/__ __/__ __ __ __ Pg __ of __

Transcect #: ____ Plot ID Num: __ __ / __ __ / __ / __ 60 ac 30 ac Recorder(s): _____
Dist# Plot# Hab T

Dist=(District)-SAL- 02, PP- 09, SPK- 10, SPL- 11 **Hab**=(Habitat Quality)-High- 1, Med- 2, Low- 3, Non/Hab- 4 **T**=(Type)-Management-0, Control-1

GPS Start Coordinates: _____ X _____ GPS datum: _____

Sub Plot Number	# Needle Clusters	# Peeled Twigs	# Cone Cores	# Fungi Digs	Sign Outside?/ Distance	Remarks
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
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57						
58						
59						
60						
61						
62						
63						
64						

GPS End Transect Coordinates: _____ X _____ GPS datum: _____

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