

Social Behavior of Abert's Squirrels in Ponderosa Pine Forests

Melissa F. Lema
W. Sylvester Allred
William S. Gaud

Department of Biological Sciences
Box 5640
Northern Arizona University
Flagstaff, AZ 86011

and
Norris L. Dodd

Arizona Game and Fish Department
Research Branch
Box 2326
Pinetop, AZ 85935

Abstract. During an ongoing 12 month radio-telemetry study, apparent social behavior was observed in Abert's squirrels (*Sciurus aberti aberti*) at two study sites near Flagstaff, Arizona. Although considered mostly a solitary species, approximately 53% of the radio-collared squirrels (n=28) exhibited communal nesting behavior at least once during the period from November 1996 through early May 1997. The pairs and trios of squirrels occupying communal nests included male/male combinations and male/female combinations. Furthermore, nest sharing occurred between both squirrels of the same age class (adult/adult, juvenile/juvenile) and squirrels of different age classes (adult/juvenile). Tree sharing behavior was also observed among the squirrels. Approximately 59% of the radio-collared squirrels (n=32) were visually located in a ponderosa pine (*Pinus ponderosa*) concurrently occupied by one or more squirrels at least once during the course of the study. Communal nesting behavior among Abert's squirrels may facilitate thermoregulation, and both communal nesting and tree sharing may reinforce social bonding and resource sharing.

Key words: Abert's squirrel, communal nesting, tree sharing, thermoregulation, social bonding

Abert's squirrels are one of six subspecies of tassel-eared squirrels endemic to ponderosa pine forests of the southwestern United States and Mexico (Brown 1984, Hoffmeister and Diersing 1978). These animals are intricately associated with the ponderosa pine ecosystem. Squirrels feed on the cones, inner bark of pine shoots, and symbiotic mycorrhizal fungi of the pines (Keith 1965, States et al. 1988, Allred et al. 1994). Tree nests are constructed from pine shoot clippings (Keith 1965). In addition, Abert's squirrels represent an important prey for the northern goshawk and hence are a vital intermediate in the forest food chain (Pogany and Allred 1995, Reynolds et al. 1992). Since this animal plays an integral role in the ecosystem, the Abert's squirrel may be considered an indicator species of ponderosa pine forest health (Allred and Gaud, 1999).

Abert's squirrels are generally considered solitary animals except during the breeding season which usually occurs from April through June (Brown 1984). However, research by Allred and Pogany (1996) has provided data that expand the known breeding period. Aside from territorial displays during the mating season, all other aggressive exchanges are thought to occur between animals occupying a common feeding area (Brown 1984). Although considered rare, communal nesting among the subspecies *S. a. ferreus* has been documented in the Rocky Mountains in Boulder County, Colorado (Halloran and Bekoff 1994). Unrelated female/male pairs constituted the majority of observed shared nests (Halloran and Bekoff 1994). However, nest sharing among kin has been documented among gray squirrels (Koprowski 1991), and researchers have suggested that female Abert's squirrels may permit one offspring to remain with them through the young's first winter (Keith 1965).

Since tassel-eared squirrels are denoted as a non-gregarious species (Brown 1984), until this research, no studies documented social behavior among this subspecies. Unlike the many colonial species of ground squirrels, sociality among these tree squirrels has not been apparent.

This study presents evidence for social behavior among Abert's squirrels in ponderosa pine forests of northern Arizona. Both nest sharing and tree sharing behaviors were documented during non-breeding months among radio-collared animals. Both of these behaviors may facilitate social bonds. In addition, as proposed by Grodzonski (1985, Golightly and Ohmart 1978), nest sharing may provide thermoregulatory benefits. Tree sharing may result from an abundant food resource, such as ovulate cones, provided by the tree.

METHODS

Abert's squirrels were trapped using Tomahawk Live Traps (#104) and radio-collared at two study sites within 20 miles of Flagstaff, Arizona. The Marshall Mesa site, an uneven aged stand with interlocking canopies, was considered good quality habitat for squirrels (Patton 1984). In contrast, the Fort Tuthill site, most recently logged in 1992, was a fairly even aged stand with few interlocking trees, a poorer quality squirrel habitat (Patton 1984). The trapping grid at each study site was composed of 144 small mammal traps and an area of 153 acres at Fort Tuthill and 177 acres at Marshall Mesa (Dodd pers. com.).

Data for this study were collected during a 12 month period from September 1996 through August 1997. Adult squirrels were trapped and radio-collared in August 1996. Juvenile squirrels were collared in October 1996. The weight of the Telonics' radio-collars was approximately 18 grams with a battery life of 10 months. Each squirrel was tracked with a hand-held H-antenna twice a week. Visual observations were used to verify each located squirrel. When the battery life of the collars terminated, individual squirrels were trapped and recollared. New squirrels were radio-collared to replace those animals lost to predation.

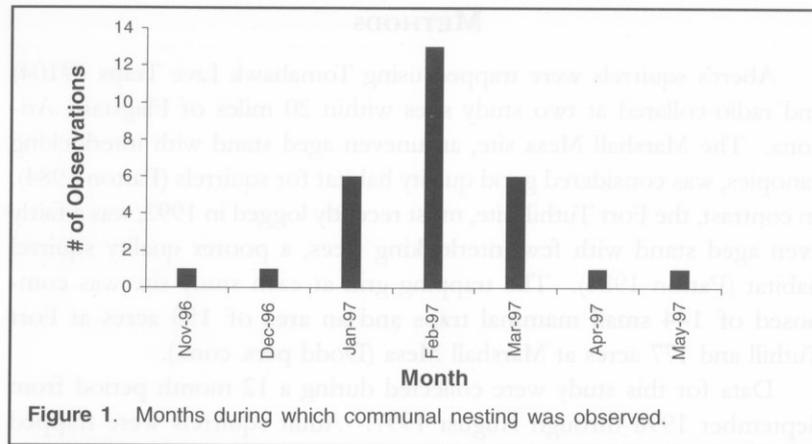
Data from both sites were pooled for G-Test analyses. Communal nesting behavior was observed among a sample of 28 squirrels during the period from November 1996 through early May 1997. Nest sharing was not observed during the remaining portion of the year. Tree sharing behavior was examined from a total sample of 32 squirrels during most of the 12 month period. These samples included both sexes (male, female) and age classes (adult, juvenile) of squirrels.

RESULTS

Data were collected from September 1996 through August 1997. Communal nesting behavior was defined as at least one observation of a radio-collared squirrel sharing a nest with another squirrel. Tree sharing behavior was defined as the observation of a radio-collared squirrel sharing a tree with another squirrel on at least one occasion.

Communal Nesting Behavior

Communal nesting was observed from November 1996 through early May 1997 (Fig. 1). Approximately 53% of the radio-collared squirrels (n=28) were located in a nest simultaneously occupied by another squirrel. At least 50% of the squirrels exhibited nest sharing behavior



($G_{adj[0.05,1]}=2.28, P<0.05$). A total of 234 nest observations were collected from the 28 radio-collared animals during the period from November through May. Shared nesting was observed in 12% of the cases. Most of the observations of nest sharing were between radio-collared squirrels. The radio-collars allowed verifications of the location of multiple squirrels in the same nest without visual observations of the animals. However, three of the shared nest observations were of one radio-collared squirrel and one non-collared animal. In these instances, the squirrels exited the nest, thereby enabling the researchers to make visual confirmations of the animals.

Sex and age class (adult, juvenile) of squirrels that exhibited communal nesting varied greatly (Table). However, the highest percentage of observations involved an adult female with an adult male (20%) or two

Table. Squirrel combinations in shared nests.

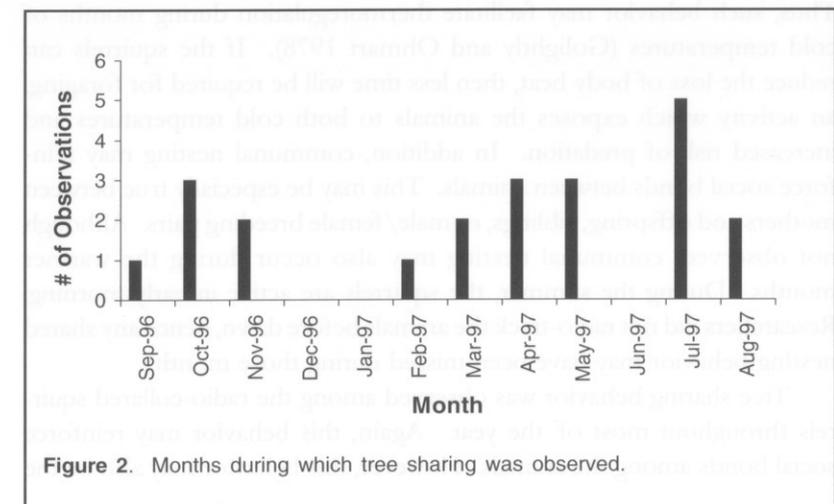
Squirrel combination	# of observations	% of observations
juv male / juv male	6	20
adult male / adult female	6	20
adult male / adult female / juv female	4	13
adult male / juv female	3	10
adult female / juv female	3	10
adult male / adult male	2	7
juv male / unknown	2	7
adult female / unknown	2	7
adult male / unknown	1	3

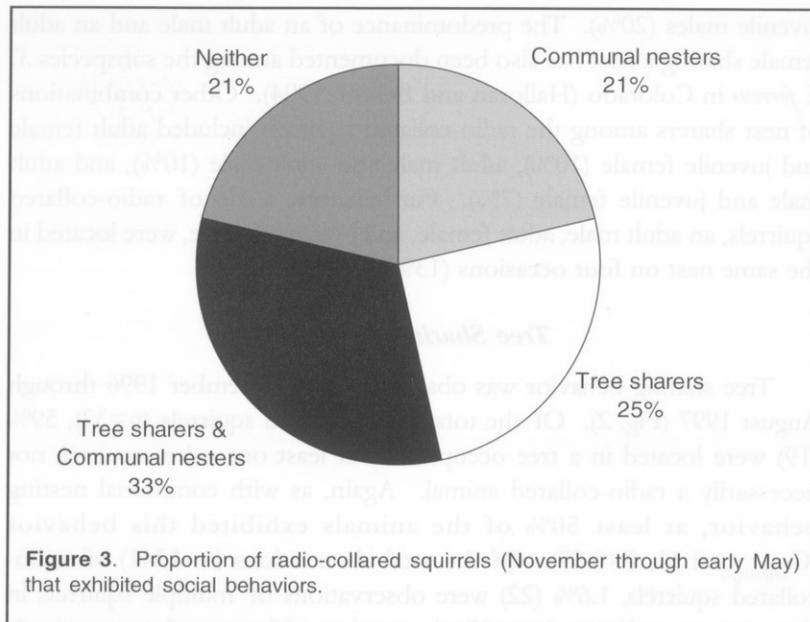
juvenile males (20%). The predominance of an adult male and an adult female sharing a nest has also been documented among the subspecies *S. a. ferreus* in Colorado (Halloran and Bekoff 1994). Other combinations of nest sharers among the radio-collared squirrels included adult female and juvenile female (10%), adult male and adult male (10%), and adult male and juvenile female (7%). Furthermore, a trio of radio-collared squirrels, an adult male, adult female, and juvenile female, were located in the same nest on four occasions (13%).

Tree Sharing Behavior

Tree sharing behavior was observed from September 1996 through August 1997 (Fig. 2). Of the total radio-collared squirrels ($n=32$), 59% (19) were located in a tree occupied by at least one other squirrel, not necessarily a radio-collared animal. Again, as with communal nesting behavior, at least 50% of the animals exhibited this behavior ($G_{adj[0.05,1]}=1.11, P<0.05$). Of the total observations ($n=1341$) of radio-collared squirrels, 1.6% (22) were observations of multiple squirrels in the same tree. From these 22 observations, 20 were of two squirrels sharing the same tree, and two were of three squirrels in the same tree.

Also, many of the radio-collared animals ($n=28$) exhibited both nest sharing and tree sharing behaviors (Fig. 3). Approximately 33% of the squirrels exhibited both behaviors, 25% were observed in a shared tree, 21% were observed in a shared nest, and 21% exhibited neither behavior.





DISCUSSION

Data from this study suggest that *S. a. aberti* are more social than previously reported. At least 50% of the radio-collared animals were observed in a shared nest. In addition, at least 50% of the squirrels were observed in a shared tree.

Nest sharing behavior was observed from November to early May. Thus, such behavior may facilitate thermoregulation during months of cold temperatures (Golightly and Ohmart 1978). If the squirrels can reduce the loss of body heat, then less time will be required for foraging, an activity which exposes the animals to both cold temperatures and increased risk of predation. In addition, communal nesting may reinforce social bonds between animals. This may be especially true between mothers and offspring, siblings, or male/female breeding pairs. Although not observed, communal nesting may also occur during the warmer months. During the summer, the squirrels are active in early morning. Researchers did not radio-track the animals before dawn, hence any shared nesting behavior may have been missed during those months.

Tree sharing behavior was observed among the radio-collared squirrels throughout most of the year. Again, this behavior may reinforce social bonds among the animals. However, this behavior may also be the

result of an abundant food resource, for example, ovulate cones or palatable terminal shoots (Keith 1965, Allred et al. 1994). The peak in tree sharing during July appears to correspond to the peak in cone production in the pines. In addition, when located in a shared tree, squirrels were frequently observed peeling cones. Consequently, it is possible that the only attractant for the squirrels to occupy a shared tree is the food resource. The animals may simply tolerate the presence of other squirrels in order to obtain the valuable cones.

Social behavior, nest sharing and tree sharing, among Abert's squirrels may be more common than this study indicates. These data are from the observations of radio-collared animals. During the 12 months of this study, the uncorrected population estimate within the trapping grid at Marshall Mesa averages approximately 39 squirrels (Dodd pers. com.). About 35% of the animals were radio-tracked. At Fort Tuthill, the uncorrected population estimate is approximately 26 animals in the winter and 43 animals in the summer (Dodd pers. com.). Squirrel movements appear to respond to food resources at that site and, therefore, population size fluctuates. Still, only approximately 32% of the squirrels were radio-tracked. Also, a visual location of each squirrel twice a week equates to about one half hour of observation time per squirrel per week. Squirrels may perform many behaviors not observed. This study provides one window into aspects of the social behavior of Abert's squirrels.

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