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NOTES

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COMMUNAL NESTING BEHAVIOR IN MEARN'S SQUIRRELS
(*TAMIASCIURUS MEARNSI*)

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ABSTRACT—Communal nesting has been observed frequently in arboreal squirrels of the genus *Sciurus* and *Glaucomys*, but only occasionally in *Tamiasciurus*. During 2006 and 2007, we trapped and radiocollared 38 adult Mearns's squirrels (*Tamiasciurus mearnsi*) in Baja California, Mexico, to examine their nesting behavior. We report for the first time instances of communal nesting in Mearns's squirrels. Same-sex groups were more common than mixed-sex groups. Females engaged more in communal nesting than males. Communal nesting behavior in Mearns's squirrels seems to be similar to other species of arboreal squirrels; decreasing as mean monthly temperature increases and during the breeding season.

RESUMEN—La anidación comunal ha sido observada frecuentemente en ardillas arborícolas del género *Sciurus* y *Glaucomys*, pero sólo ocasionalmente en *Tamiasciurus*. Durante 2006 y 2007, atrapamos y pusimos radio collares a 38 ardillas adultas de San Pedro Mártir (*Tamiasciurus mearnsi*) en Baja California, México, para examinar su comportamiento de anidación. Reportamos por primera vez casos de anidación comunal en las ardillas de San Pedro Mártir. Grupos del mismo sexo fueron más comunes que grupos de sexo mixto. Las hembras participaron más en anidación comunal que los machos. El comportamiento de anidación comunal en las ardillas de San Pedro Mártir parece ser similar a otras especies de ardillas arborícolas; disminuyendo conforme la temperatura media mensual aumenta y durante la temporada reproductiva.

Communal nesting, the occurrence of multiple individuals of the same species in the same nest, has been documented frequently in tree squirrels of the genus *Sciurus* (Halloran and Bekoff, 1994; Koprowski, 1996; Lema et al., 1999; Thorington and Ferrel, 2006; Edelman and Koprowski, 2007) and in flying squirrels of the genus *Glaucomys* (Weigl and Osgood, 1974; Layne and Raymond, 1994; Reynolds et al., 2009). However, this behavior occasionally has been observed in tree squirrels of the genus *Tamiasciurus* (Munroe et al., 2009), presumably due to their territorial behavior (Smith, 1968; Flyger and Gates, 1982; Gurnell, 1984). The genus *Tamiasciurus* contains three species: *T. douglasii*, *T. hudsonicus*, and *T. mearnsi* (Thorington and Hoffmann, 2005). Throughout most of their range, *T. douglasii* and *T. hudsonicus* defend exclusive territories against conspecifics and other competitors (Steele, 1998, 1999). The Mearns's squirrel (*T. mearnsi*) is a poorly known endemic species that occurs only in the coniferous forests of the Sierra de San Pedro Mártir, Baja California, Mexico (Lindsay, 1981). The species is federally listed as threatened in Mexico

(Secretaría de Medio Ambiente y Recursos Naturales, 2010) and as endangered by the International Union for Conservation of Nature and Natural Resources (www.iucnredlist.org). Herein, we report for the first time communal nesting in Mearns's squirrels.

We conducted our study in Sierra de San Pedro Mártir National Park ca. 100 km SE Ensenada, Baja California, Mexico. Vegetation (Stephens et al., 2003) was Jeffrey pines (*Pinus jeffreyi*), sugar pines (*P. lambertiana*), lodgepole pines (*P. contorta*), and white firs (*Abies concolor*), with some quaking aspens (*Populus tremuloides*) and incense cedars (*Calocedrus decurrens*). The most striking feature of the mixed-conifer forests in the Sierra de San Pedro Mártir is the open park-like aspect that consists of mature trees reaching 30–45 m, with few pole-sized trees and saplings, and an open shrub cover (Bojórquez-Tapia et al., 2004).

During 2006 and 2007, we captured 38 adult Mearns's squirrels (20 males, 18 females) in the surroundings of Vallecitos Meadow to examine their nesting behavior. Live-traps (Model 201; Tomahawk Live Trap Co., Hazel-

hurst, Wisconsin) were placed at the base of large-diameter trees, baited with peanuts and peanut butter, covered with bark, and checked at 1-h intervals. Captured squirrels were transferred to a cloth-handling cone (Koprowski, 2002) where we collected data on sex, age, reproductive condition, and mass. Adult animals (≥ 240 g) were fitted with radiocollars (Model SOM-2190; Wildlife Materials International, Inc., Carbondale, Illinois) that weighed $<5\%$ of mass of body, and uniquely numbered, Monel ear-tags (Style 1005-1; National Band and Tag Co., Newport, Kentucky) with colored plastic washers (Style 1842; National Band and Tag Co., Newport, Kentucky) on both ears. We distinguished adults and juveniles based on reproductive condition and mass of captured animals. Trapping and handling of animals was conducted with approval from The University of Arizona Institutional Animal Care and Use Committee and permits from the following Mexican authorities: Dirección Forestal y de la Fauna Parque Nacional Sierra de San Pedro Mártir and Dirección General de Vida Silvestre.

We tracked squirrels to their nests after sunset using a 3-element yagi directional antenna (Wildlife Materials International, Inc., Carbondale, Illinois) and receiver (Model R-1000; Communications Specialists, Inc., Orange, California). We tracked squirrels monthly in spring (April) and autumn (September–November) and weekly during summer (May–August); we did not monitor squirrels in winter (December–March). Instances ($n = 7$) where we were unable to determine whether ≥ 2 squirrels were nesting communally or using different cavities in the same tree were removed from the analysis and counted as individual nesting events.

Mearns's squirrels did not use leaf nests (Koprowski et

al., 2006), also known as dreys, relying only on tree cavities for nesting. We found squirrels communally nesting during 2007, in 23 of 306 (7.52%) nesting events observed, but not during 2006 (0 of 118 nesting events), and during the warmest months (May–August; Fig. 1). In total, we confirmed 11 instances of communal nesting with 2–4 squirrels/nest (Fig. 1). While none of the 18 radiocollared squirrels monitored in 2006 engaged in communal nesting, 12 of the 27 squirrels monitored in 2007 did. Of these 12 squirrels, 9 were nesting alone in their own cavities before nesting with other squirrels at least once. Squirrels nested frequently with different partners. Only 4 of the 12 squirrels engaged in communal nesting were nesting with the same partner ≥ 2 times; groups of two individuals in each instance. Squirrels nested with the same partners ≤ 5 times/month and for ≤ 2 months. However, because we did not monitor animals daily, it is unknown whether squirrels communally nested with the same partners all the time. We were unable to determine relatedness of individuals. Kinship influences composition of nesting groups of adult female eastern gray squirrels *Sciurus carolinensis* (Koprowski, 1996), and in southern flying squirrels *Glaucomys volans* (Thorington et al., 2010; Thorington and Weigl, 2011).

Same-age groups ($n = 10$) consisting of only adults were more common than mixed-age groups ($n = 1$) that also included subadults. Squirrels communally nested more often in groups of two ($n = 8$) than in groups of three ($n = 2$) or four ($n = 1$). Same-sex groups ($n = 7$) were more frequent than mixed-sex groups ($n = 4$). Same-sex groups have been documented as more frequent in *S. carolinensis* and eastern fox squirrels *S. niger* (Koprowski, 1996), while mixed-sex groups are more common in Abert's squirrels *S. aberti* (Lema et al., 1999; Edelman and Koprowski, 2007) and *G. volans* (Layne and Raymond, 1994; Reynolds et al., 2009). Same-sex and mixed-sex groups, consisting of two individuals, have been documented occasionally in *T. h. grahamensis* (Munroe et al., 2009). Same-sex groups consisting of two adult females ($n = 4$) were more common than groups of two adult males ($n = 1$). Similarly, groups of three ($n = 2$) consisted of only adult females. Sex ratio (male:female) for all radiocollared squirrels did not differ significantly (1.25:1; $\chi^2 = 0.052$, $df = 1$, $P = 0.819$), suggesting that communal nesting by only males is not common in Mearns's squirrels. In other arboreal squirrels, such as *G. volans* (Reynolds et al., 2009), *S. aberti* (Edelman and Koprowski, 2007), *S. carolinensis*, and *S. niger* (Koprowski, 1996), same-sex groups consisting of only males were more frequent than groups of only females. Most mixed-sex groups consisted of two adults ($n = 3$), with only one group consisting of an adult male, an adult female, a subadult female, and a subadult of unknown sex ($n = 1$).

In contrast to the other two *Tamiasciurus* that defend territories centered around larderhoards of food, known

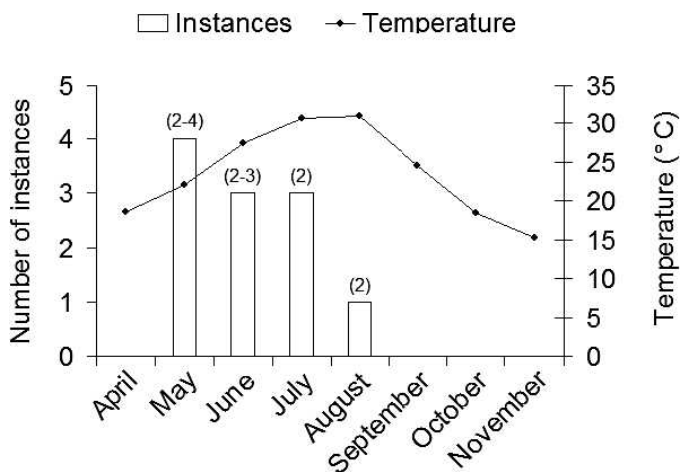


FIG. 1.—Confirmed instances of Mearns's squirrels (*Tamiasciurus mearnsi*) communally nesting during 2007 in the Sierra de San Pedro Mártir, Baja California, Mexico, size of nesting groups (in parentheses), and mean monthly temperatures (Servicio Meteorológico Nacional) during 2007 at Ejido San Matías, ca. 25 km N Sierra de San Pedro Mártir.

as middens, throughout most of their range (Steele, 1998, 1999), Mearns's squirrels do not build these structures to store food; apparently, due to xeric conditions in forests of the Sierra de San Pedro Mártir (Koprowski et al., 2006). As a result, Mearns's squirrels only cache food in branches of trees, known as scatterhoards, and their behavior is more evasive and less vocal and aggressive than the other two *Tamiasciurus* (Steele, 1998, 1999). This may account in part for their nonterritorial behavior (Gurnell, 1987) and their acceptance to communally nest like *Sciurus* and *Glaucomys*. Under experimental conditions, individuals of *T. hudsonicus* lost their territorial behavior and communally nested with other conspecifics and with *S. carolinensis* (Ackerman and Weigl, 1970). Although populations of *T. hudsonicus* in the northeastern portion of the range show a behavior similar to that described here for Mearns's squirrels (Layne, 1954), no record of communal nesting in these populations exists (Munroe et al., 2009).

Communal nesting has a thermoregulatory function in winter by reducing expenditure of energy for maintaining body temperature (Layne and Raymond, 1994; Hayes, 2000; Merritt et al., 2001). However, during the warmest months of summer, communal nesting may be unnecessary and even detrimental, especially for breeding females (Winterrowd et al., 2005; Edelman and Koprowski, 2007). In some species of arboreal squirrels, communal nesting decreases during summer as mean monthly temperatures increase and during the breeding season (Layne and Raymond, 1994; Koprowski, 1996; Edelman and Koprowski, 2007). When contrasting communal nesting in Mearns's squirrels with temperature during 2007, we observed that number of instances and size of nesting groups apparently decreased as mean monthly temperatures increased (Fig. 1). Communal nesting also seemed to be influenced by breeding season. While six of the eight radiocollared females monitored in 2006 were lactating at least once from May–September (the other two died shortly after their first capture), only two of the 12 females monitored in 2007 were lactating in August and were not engaged in communal nesting at the time (Fig. 1). Communal nesting in Mearns's squirrels seems similar to other species of arboreal squirrels. However, more research is needed, especially during winter.

The absence of middens (Koprowski et al., 2006), communal nesting behavior, and ≥ 2 squirrels nesting in different cavities of the same tree, suggest that Mearns's squirrels, unlike the other two *Tamiasciurus* (Flyger and Gates, 1982; Steele, 1998, 1999), have lost the territorial behavior characteristic of the genus. However, plasticity in territorial behavior occurs within *T. hudsonicus* (Layne, 1954). We believe that because of the open and arid characteristics of their habitat (Bojórquez-Tapia et al., 2004), Mearns's squirrels have developed unique adaptations to persist in the Sierra de San Pedro Mártir. More information about Mearns's squirrels is needed to aid in

their conservation, and to understand more about communal nesting behavior and evolution of territoriality in *Tamiasciurus*.

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HOME RANGES OF FEMALE RIO GRANDE TURKEYS (*MELEAGRIS GALLOPAVO INTERMEDIA*) IN SOUTHERN TEXAS

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