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Documentation of Replacement of Native Western Gray Squirrels by Introduced Eastern Fox Squirrels

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Abstract.—The eastern fox squirrel (*Sciurus niger*) was first introduced to Los Angeles in 1904. Since that time, this species has spread throughout many of the urban and suburban areas of Los Angeles, Ventura and Orange Counties. In this paper we document that the eastern fox squirrel can replace the western gray squirrel within a particular habitat in a short period of time.

The eastern fox squirrel *(Sciurus niger)* has generally remained restricted to areas of human habitation throughout southern California since its introduction into Los Angeles in 1904 (Becker and Kimball 1947; King 2004). However, with continued range expansion the fox squirrel has come into contact with the native western gray squirrel (*Sciurus griseus*) in many foothill areas (Hoefler and Harris 1990; Ingles 1954). *Sciurus niger* has also come into contact with populations of *S. griseus* that have become isolated from larger populations due to the establishment of new suburban housing tracts and freeways, and the resulting fragmentation of habitat.

Within the past 30 years, residents of Los Angeles County have noticed a decline in the number and range of western gray squirrels coinciding with an increase in the number of eastern fox squirrels (Byhower 2002; Byhower and Lokitz 2000). Some habitats that contained *S. griseus* in the past now contain only *S. niger*. Although one may want to invoke competitive exclusion for the replacement of *S. griseus* by *S. niger*, replacement is confounded by an increase in suburban development and the fragmentation of the remaining wooded habitat. For example, residential and commercial development in areas such as the Santa Susana Mountains of Los Angeles and Ventura Counties eliminated prime gray squirrel habitat at a rate of approximately 1,400 acres per year up to 1999 (Polakovic 1999).

In this paper we document replacement of *S. griseus* by *S. niger* in a habitat that had not been recently modified. The elimination of *S. griseus* from this area supports but does not confirm the idea of competitive exclusion of *S. griseus* by *S. niger* from certain, but not all, types of habitats. Additional studies would be needed to determine how *S. niger* is capable of replacing *S. griseus* in specific habitats.

The presence of *S. niger* in various areas of Los Angeles, Orange, San Bernardino, and Ventura Counties of southern California was assessed by King (2004) using, among other methods, an online response form (Sue et al. 2002) where people could report the presence of *S. niger*. A report was received May 17, 2005 documenting the first sighting of

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S. niger on the campus of California State Polytechnic University, Pomona in Pomona, CA. The sighting, by author GRS was reported in the main quad area of the campus, adjacent to Building # 8. Since Building # 8 is located near the middle of the campus, *S. niger* could have been present on the southern or western periphery of the campus prior to May 2005. The most likely route of approach by the squirrels to the campus was from the west (see King 2004 for a historical distribution map).

A population of *S. griseus* existed at the University for at least 45 years during the time that author GRS worked at the campus. Although many buildings have been constructed on the campus over the years, very little landscape modification has occurred since 2003. With a documented first occurrence of *S. niger* in the first half of 2005, and follow-up surveys occurring on an irregular basis, we were able to document the fate of *S. griseus* on the campus and establish a general timeline for the fate.

Prior to 2005 *S. griseus* were commonly observed on the main quad area of the campus, near various buildings on campus, in a heavily wooded area adjacent to Kellogg Center West (a major conference center on the campus), and in a heavily wooded area to the west of the center of campus (the Voorhis Ecological Reserve). *Sciurus niger* was initially sighted on an infrequent basis but by 2006 this species was a common sight. While *S. griseus* could be regularly observed on the main quad area in 2005, the species has not been observed on the quad area since 2006. Also, no western gray squirrels were sighted during annual field walks with students in a mammalogy course through the heavily wooded area of the Voorhis Ecological Reserve in September of 2007 and 2008.

Visual surveys around the main campus quad area, the heavily wooded area adjacent to Kellogg Center West, and the heavily wooded area in the Voorhis Ecological Reserve were conducted on 22 separate occasions during January, February, March, April, October, November and December of 2008 and each month January through July of 2009 ($>$ 40 hours of observation time). While many eastern fox squirrels were observed during most surveys, only one western gray squirrel was ever observed during any survey. What appeared to be the same individual was observed in a grove of walnut trees just to the east of Camphor Lane near Kellogg Center West by several students in the mammalogy course during October and November of 2008. A lone western gray squirrel was also observed in the same area in December 2008 and in January, February, June and July of 2009. Based upon these sightings, the population of western gray squirrels appears to have been reduced to a single individual remaining on the campus.

The eastern fox squirrel has been introduced into many western states (Flyger and Gates 1982; Jordan and Hammerson 1996). Within California, introduced fox squirrel colonization is not specific to the Greater Los Angeles Metropolitan Area. For example, *S. niger* were introduced to Golden Gate Park in San Francisco before 1890 (Byrne 1979), to Roeding Park in Fresno in 1900 or 1901 (Storer papers; Lidicker 1991), to Balboa Park in San Diego from the San Diego Zoo in 1920 (Staff Writer 1929), to the campus of the University of California, Berkeley circa 1926 (Boulware 1941), to Mt Diablo in 1960 (Pelonio 2004) and to the city of Bakersfield in 1985 (Sheehey 2004).

While there has been a correlation between the disappearance of *S. griseus* from certain habitats after the appearance of *S. niger* in those habitats (examples, Lacy Park in San Marino, Lanterman Developmental Center in Pomona, a residential area in Altadena adjacent to Eaton Canyon) we report here a documented case, with a timeline, where western gray squirrels have been replaced by eastern fox squirrels at a specific location. While the first sighting of *S. niger* on the campus of California State Polytechnic University, Pomona was in May of 2005, a very significant reduction in observation of *S.*

griseus was evident within 1 year. The virtual elimination of the western gray squirrel from the campus occurred in less than 4 years.

King (2004) studied co-existing populations of *S. niger* and *S. griseus* in San Dimas Canyon Park within the city of San Dimas, CA where the two species have now coexisted for at least 15 years. Although *S. niger* is able to quickly replace *S. griseus* in certain habitats, the two species can coexist within other habitats. In addition to San Dimas Canyon Park the two species coexist at the Bird Sanctuary in Griffith Park, Walnut Creek Park within the City of San Dimas, CA, and the main quad area and a semi-natural area at Pomona College in Claremont, CA.

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