

San Bernardino flying squirrel, *Glaucomys sabrinus californicus**Philip V. Brylski*

Description: This is a medium-sized squirrel; TL about 260 mm. Maximum weights observed in one study of *G. s. californicus* were 140 g for females and 158 g for males (Butler et al. unpubl. report). Flying squirrels are nocturnal and secretive and therefore rarely observed, but are easily distinguished from other sympatric arboreal squirrels (*Sciurus* and *Tamiasciurus*) by the presence of a furred patagium connecting the fore and hind limbs from ankle to wrist.

Taxonomic Remarks: The San Bernardino flying squirrel was described by Rhoads (1897) based on specimens collected near Squirrel Inn, San Bernardino Mountains at 1585 m. Recent studies based on mitochondrial DNA indicate that populations of *sabrinus* on the west coast (based on samples from populations in southern California and coastal Oregon and Washington) are genetically distinct from *sabrinus* east of the Rocky Mountains and may warrant status as a separate species (Arbergast unpubl. manuscript). Additional genetic studies of California *sabrinus*, including *s. californicus* are planned (P. Weigl pers. comm.).

Distribution: The San Bernardino flying squirrel historically occurred as three isolated populations at the southern edge of the range of *sabrinus* in the forests of the San Gabriel, San Bernardino, and San Jacinto mountains. Museum records are restricted to several localities in the San Bernardino Mountains and a single locality (Idyllwild) in the San Jacinto Mountains. Vaughan (1954a) reported *sabrinus californicus* from the San Gabriel Mountains, but there apparently are no museum records for that locality. The movement of individuals among populations is interrupted by the Cajon Pass (between the San Gabriel and San Bernardino mountains) and the San Geronio Pass (between the San Bernardino and San Jacinto mountains). Its nearest conspecific population is 265 km to the north in the Sierra Nevada. There is no current information on the San Gabriel and San Jacinto mountains populations. Flying squirrel surveys in the San Bernardino National Forest, based on live-traps and identification of flying squirrel remains in pellets collected from nest sites of California spotted owl (*Strix occidentalis occidentalis*), indicate that flying squirrels are found in forests between approximately 1,200 and 2,500 m elevation. The distribution is fragmented by natural variation in vegetation cover (e.g., along the Santa Ana River wash), an apparent preference for high elevation habitats, and barriers such as forest cover loss resulting from ski developments and the 1978 Big Bear fire.

Life History: There have been few studies on the San Bernardino flying squirrel. This summary of the species' biology is based on studies on various subspecies of the northern flying squirrel, *Glaucomys sabrinus* (Wells-Gosling and Heaney 1984). Northern flying squirrels are thought to be active year-round, nesting in both tree cavities and stick nests. Tree cavities and stick nests used by *californicus* were found in live trees and snags of Jeffrey pine (*Pinus jeffreyi*) and white fir (*Abies concolor*) (Butler et al. unpubl. manuscript). Cavity nesting is thought to be more important during the winter, when groups of squirrels may nest together to conserve heat. Breeding generally occurs in April and May, with two to four young produced 37 to 42 days after mating (Muul 1969, Soper 1973). Juveniles have been reported in the fall and winter, indicating that reproduction can potentially occur year-round, given the appropriate environmental conditions.

Food items of northern flying squirrels include acorns and other nuts, conifer and hardwood seeds, wild fruits, insects, fungi and lichen, and tree sap. It is not known whether the food habitats of *californicus* differ from this, nor is the relative importance of these kinds of diet items known. In a study of flying squirrels in northeastern California, fungi and lichens were common diet items, as revealed by pellet analysis, and captive animals showed a preference for fungal sporocarps (fruiting

bodies; Waters and Zabel unpubl. manuscript). In the same study, the density of flying squirrels was correlated with the abundance of fungal sporocarps in the leaf litter and upper surface of mineral soil.

Flying squirrels are important prey items for the Threatened spotted owl in northern California, and have been detected in the pellets of southern spotted owls in the San Bernardino Mountains (Butler et al. unpubl. manuscript).

Habitat: *G. sabrinus* occurs in a range of coniferous and deciduous forest, including riparian forests. The San Bernardino flying squirrel has been reported in mixed conifer forests of Jeffrey pine and white fir. Sumner (1927) reported the habitat as white fir and black oak (*Quercus kelloggii*) woodlands. The literature contains different conclusions on the importance of old growth versus second-growth stands and the density of suitable tree cavities as habitat parameters that influence squirrel densities. In the fir forests of northeastern California studied by Waters and Zabel (unpubl. manuscript) flying squirrels were not old-growth specialists, although squirrel densities were higher in old growth than in young stands, a result also reported by Carey et al. (1992) and Rosenberg and Anthony (1992). In the unpublished study by Waters and Zabel, flying squirrel densities were not correlated with the densities of tree cavities. This result is expected in areas with high cavity densities and should not be generalized across the species' range. The Appalachian flying squirrel (*G. s. coloratus*) of the eastern U.S. prefers ecotones and mosaics of conifer and hardwood forest (Weigl and Knowles unpubl. manuscript). Whether this characterizes the habitat preferences of *G. s. californicus* is unknown.

Populations of northern flying squirrels are adversely affected by habitat fragmentation. Rosenberg and Raphael (1984) found that in northwestern California, the abundance of squirrels increased with stand size, they were generally absent in stands smaller than 20 ha, and approximately 75% of stands over 100 ha had flying squirrels. An additional problem with fragmented habitats is the constraints that open spaces pose to the movements of individuals and the colonization of unoccupied habitat patches. Mowrey and Zasada (1982) reported an average gliding distance of about 20 m in *sabrinus*, with a maximum of 48 m, and concluded that movements are unimpeded in areas with average openings of 20 m and occasional openings of 30 to 40 m.

Status: Class II. There are few data available on populations of *G. s. californicus*. This species is included on the Special Concern list because of its occurrence in restricted, disjunct populations, a lack of information on the two smallest populations, comparatively low densities of individuals in populations that have been studied, and ongoing habitat fragmentation as a result of development and forest practices within the species range. The species historically existed in three disjunct populations in the San Gabriel, San Bernardino, and San Jacinto mountains. There is no information available on the flying squirrels in the San Gabriel or San Jacinto mountains. In studies of the San Bernardino Mountains population, the frequency of captures (expressed per 1,000 functional trap nights) and the densities of flying squirrels (generally not calculated due to low numbers of captures), were substantially lower compared to flying squirrel studies in northern California and Oregon. The population densities of *sabrinus californicus* are comparable to densities observed in the Federally Endangered Appalachian Mountains flying squirrel (*G. s. coloratus*). The distribution of the San Bernardino population is fragmented by natural variation in vegetation cover (e.g., north and south of the Santa Ana River wash), an apparent preference for high elevation habitats, and barriers such as forest cover loss resulting from the 1978 Big Bear fire and ski developments. The San Bernardino population is at risk of being further subdivided by long-term plans for ski resort expansions. Due to its proximity to the Los Angeles basin, the recreational uses of the San Bernardino Mountains are expected to intensify for the foreseeable future. Impacts from recreational activities, and attendant development pressures, are expected to increase in the future. The restricted

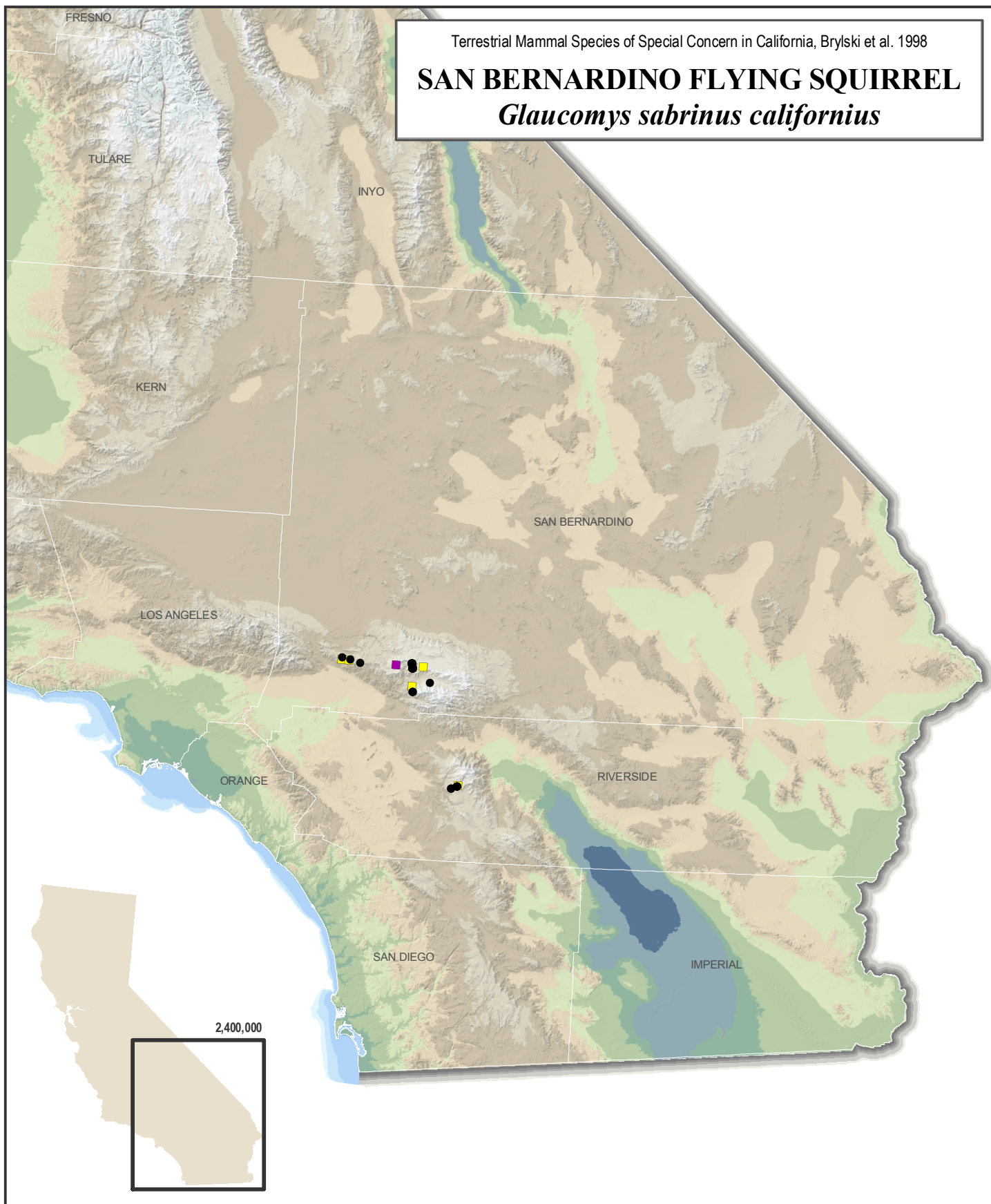
distribution of *G. s. californicus*, its relatively low densities, its susceptibility to population subdivision caused by deforested swaths as narrow as 30 m wide, and identified threats are the reasons for its Special Concern status.

Management Recommendations: Most or all of the habitat of *G. sabrinus californicus* appears to be within the San Bernardino National Forest. The USFS habitat management recommendations are to restrict development to the existing urban centers within the forest, and to maintain forest cover by maintaining mixed age and species stands with target densities of snags and logs. The Interim Habitat Management Guidelines (IHMG) for the San Bernardino flying squirrel call for a minimum density of ten snags per 5 acres, giving preference to trees over 20 in (51 cm) dbh, and a minimum of nine down logs of all age and decay classes per acre (Butler et al. unpubl. manuscript). Field studies are needed on the distribution and abundance of *G. sabrinus californicus* in the San Gabriel and San Jacinto mountains. Additional studies on the distribution and abundance of flying squirrels in the San Bernardino National Forest are needed to guide the implementation of these policies with regard to flying squirrel management. An important question for further study is whether the flying squirrel population is currently fragmented (e.g., by barriers such as treeless areas), and whether extant populations are susceptible to further fragmentation as a result of current land use practices. Enforcement of the IHMGs should be closely monitored to maintain travel corridors that connect large but disjunct habitat patches. Additional genetic studies of *G. sabrinus californicus*, are needed to determine whether the San Bernardino flying squirrel is genetically unique or highly differentiated from other populations, and to obtain estimates of gene flow between known populations.

Terrestrial Mammal Species of Special Concern in California, Brylski et al. 1998

SAN BERNARDINO FLYING SQUIRREL

Glaucomys sabrinus californius



- Locations verified by authors
(captures, observations, museum records)

■ CNDDDB 1979 -1998

■ CNDDDB 1978 and before