

# Ratios of Adults to Juveniles Vary by Land Cover for Red-tailed Hawks Wintering in California's Central Valley

Edward R. Pandolfino<sup>1</sup>, Lowell Young<sup>2</sup>, Zach Smith<sup>3</sup>

<sup>1</sup>1328 49<sup>th</sup> Street, Sacramento, CA 95819; [erpfromca@aol.com](mailto:erpfromca@aol.com)

<sup>2</sup>1064 E. Spruce Ave., Apt. 101, Fresno, CA 93720; [yosemite.birder@gmail.com](mailto:yosemite.birder@gmail.com)

<sup>3</sup>PO Box 1032, Patagonia, AZ 85624; [cherrug@protonmail.com](mailto:cherrug@protonmail.com)

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## ABSTRACT

We used data from a three-year study of raptor winter land cover associations throughout the Central Valley, and 14 years of year-round surveys along a transect (the Le Grand transect) in the Sierra Nevada foothills in eastern Merced and western Mariposa counties of California to compare relative winter abundance of adult and juvenile Red-tailed Hawks (*Buteo jamaicensis*) in various land cover types. We found that adult:juvenile ratios for Red-tailed Hawks were significantly greater in grassland, savanna, and rural residential land covers than in others covers. The ratios in most other land covers did not differ significantly from the overall ratio of approximately six to one. Two land cover types generally avoided by most Red-tailed Hawks (vineyards and orchards), showed significantly lower adult:juvenile ratios, while one cover type highly favored by the species (rice) also showed lower adult:juvenile ratios. Examining year-round data from the Le Grand transect, 90% of which occurs in grassland and oak savanna, we observed a pattern suggesting that juveniles vacate grassland/savanna areas in late summer and that the influx of wintering Red-tailed Hawks did not include more than a few juveniles. Several authors have suggested that juvenile Red-tailed Hawks are excluded from the highest quality habitats, presumably by resident and migrant adults. Our data showed significant differences in the distribution of adults and juveniles among land covers, but our results did not support the hypothesis that juveniles are generally excluded from the best habitats. We discuss implications of our findings with regard to mechanisms to explain this difference in distribution of adults and juveniles among land cover types.

The first winter in a raptor's life is particularly difficult. Young birds must quickly learn how and where to find prey and how to efficiently subdue it. They must deal with adults defending established winter territories and learn whether to challenge those adults. As a result of these and other challenges, most young raptors do not survive their first winter. Newton (1979) concluded that first year survival for nearly all raptor species rarely exceeds 50%. After the crucial first winter, annual survival rates improve dramatically (typically to 80% or greater). Studies of Red-tailed Hawks (*Buteo jamaicensis*) estimate that first year mortality ranges from 50 to 75% and annual mortality rates fall to less than 20% after the first year (Luttich et al. 1971, Preston 2000). Thus, understanding the population dynamics for raptors requires understanding the key factors that influence their survival during their first winter.

California, and the Central Valley in particular, support one of the largest populations of wintering Red-tailed Hawks in North America (Preston 2000, Pandolfino 2006, Fink et al. 2024). The winter populations consist of local breeders that maintain year-round territories (Fitch et al. 1946, Grinnell and Miller 1944, Preston 2000, Preston and Beane 2024) and an influx of larger numbers of migrants from elsewhere in western North America (Bloom et al. 2015, Fink et al. 2024, Preston and Beane 2024). Therefore, juvenile Red-tailed Hawks attempting to winter in this area find that their search for habitat that supports an adequate concentration of prey is complicated by the possibility that resident adults already occupy these habitats. In addition, as the season progresses, more wintering adult Red-tailed Hawks arrive seeking good quality habitat. Anecdotal reports from Wisconsin (Orians 1955), Arkansas (Garner and Bednarz 2024), Oklahoma (Lowe 1978, Lish and Burge 1995, Lish 2015), Georgia (Sexton 2005), and Nebraska (Schoenebeck et al. 2014) suggested that wintering juvenile Red-tailed Hawks occupied lower quality habitats than adults. These authors speculated that adults actively exclude juveniles from the best habitats. However, none of these studies provided statistically significant data to support differences in occupied habitat or evidence for active exclusion of juveniles by adults.

We tested the hypothesis that juvenile Red-tailed Hawks are forced into lower quality habitats during winter in California's Central Valley by comparing adult:juvenile ratios using three years of data on land cover associations (Pandolfino et al. 2011). We also used 14 years of year-round data from one of those routes (the Le Grand transect, Young et al. 2025) to examine the dynamics of this ratio throughout the year there.

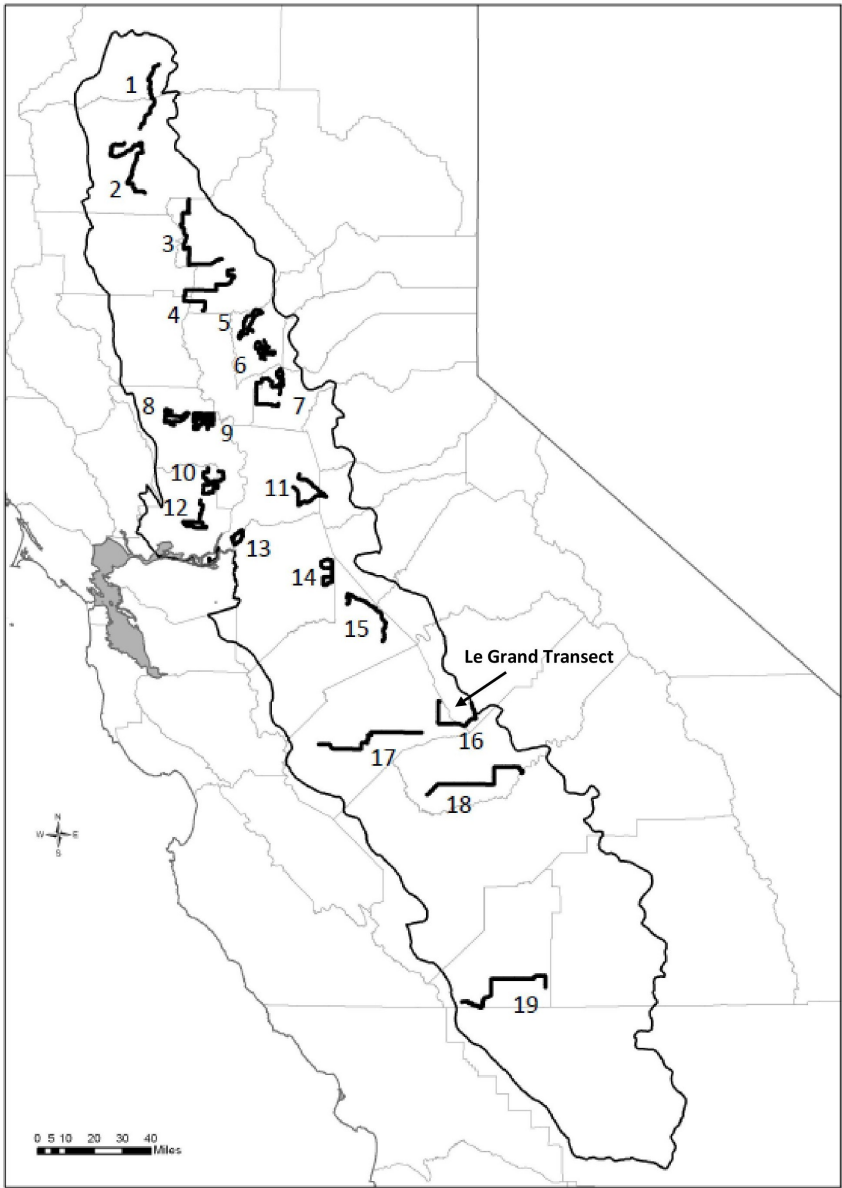


Figure 1. The Central Valley, California, and the 19 survey routes used to assess land cover associations of diurnal wintering raptors, 2007–2010. (1 = Shasta, 2 = Tehama, 3 = Butte North, 4 = Butte South, 5 = Yuba, 6 = Beale, 7 = Lincoln, 8 = Dunnigan Hills, 9 = Woodland, 10 = Davis, 11 = Folsom, 12 = Jepson, 13 = Delta, 14 = Linden, 15 = Oakdale, 16 = LeGrand, 17 = Los Banos, 18 = Madera, 19 = Kings).

## STUDY AREA

The study area encompassed the Central Valley and the lower foothills of the Sierra Nevada and Coast Ranges (Figure 1) as described in detail by Pandolfino et al. (2011). All 19 routes were surveyed in winter for three winters (from 2007–08 through 2009–10). One route, the Le Grand transect, was also surveyed year-round from 2011 to 2025. That transect is in eastern Merced and western Mariposa counties along the eastern edge of the San Joaquin Valley and the western foothills of the Sierra Nevada (Figure 1) and is described in detail by Young et al. (2025). The land cover along this transect consists almost entirely of grassland (80%) and oak savanna (10%). Other land covers along the 19 survey routes include alfalfa, grassland, orchards, hay and other forage crops, irrigated pasture, rice, row crops, savanna, vineyards, wetlands, and rural residentials (i.e., ranchettes and small farms). Detailed descriptions and the relative proportion of each land cover are described elsewhere (Pandolfino et al. 2011, Pandolfino and Smith 2011); however, in those publications, the term “urbanized” is used instead of rural residentials.

## METHODS

The survey protocol used for the three-year winter study throughout the Central Valley and for the Le Grand transect was described in detail by Pandolfino et al. (2011). These surveys were roadside area searches intended to count every raptor or Loggerhead Shrike (*Lanius ludovicianus*) observed within 500 m. Species, behavior, and location (mileage along the transect) were recorded for each bird, and when possible, the age, sex, and plumage morph were also noted. The original protocol required at least one survey per month for the winter months of December through February. The land cover type was also recorded along the transect every 800 m so that each observation could be associated with a dominant cover type. Year-round surveys of the Le Grand transect occurred between March 2011 and May 2025 (171 surveys).

## RESULTS

During the three winters of the Central Valley wide surveys, we obtained 7,950 Red-tailed Hawk observations. Ages were determined for 6,309 (79%) of those observations. The overall adult:juvenile ratio across all transects and all land covers was 6:1. The adult:juvenile ratio was significantly higher than expected in grassland, savanna, and rural residentials, and significantly lower in vineyards, orchards, hay, and rice (Figure 2).

Monthly data from the year-round surveys (Figure 3) of the Le Grand transect showed that few juvenile Red-tailed Hawks were present from August through March. The number of juveniles increased from April to May and peaked in June. The numbers declined in July, with August recording the fewest juveniles of any month.

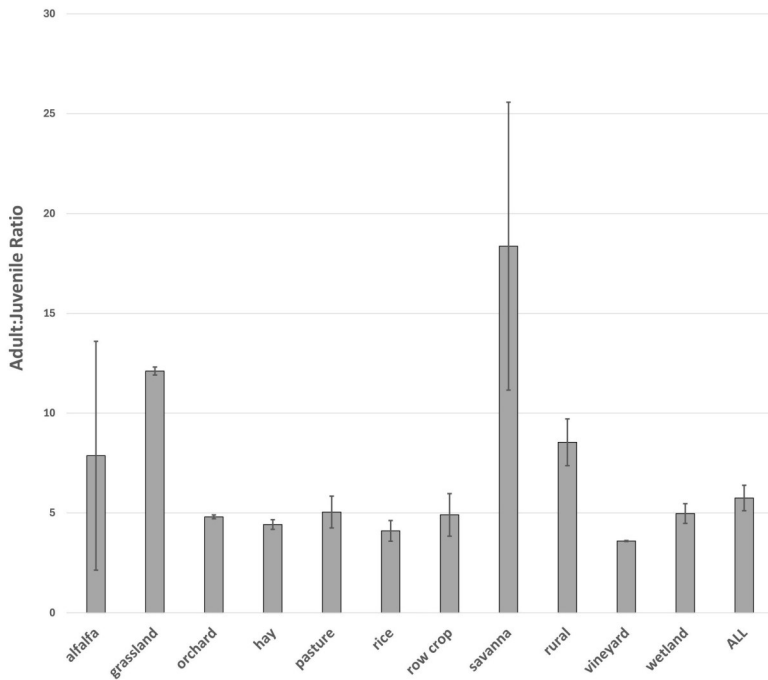


Figure 2. Ratios of adult to juvenile Red-tailed Hawks in various land cover types across all 19 survey routes, 2007–2010. Error bars represent standard error among years.

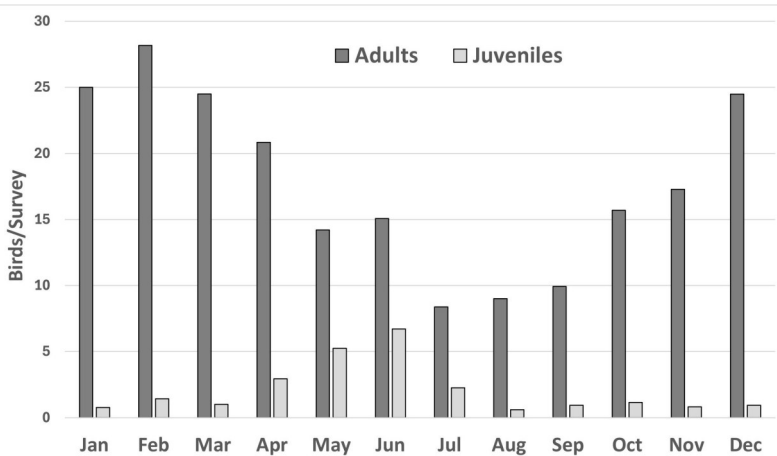


Figure 3. Relative abundance by month of adult and juvenile Red-tailed Hawks on the Le Grand Transect, 2007–2025.

## DISCUSSION

Using the same three-year data set used for this study, Pandolfino et al. (2011) found that Red-tailed Hawks in winter were found significantly more often than expected in four land cover types: wetland, flooded rice fields, alfalfa, and irrigated pasture. They occurred significantly less often than expected in areas of intense agriculture (row crops, orchards, vineyards), rural residentials, and oak savanna. Based on the hypothesis that wintering juveniles are forced into lower quality land covers, as suggested by others (Orians 1955, Lowe 1978, Lish and Burge 1995, Sexton 2005, Schoenebeck et al. 2014, Lish 2015, Garner and Bednarz 2024), one would expect that the ratios of adults to juveniles would be highest in wetland, rice, alfalfa, and irrigated pasture, and lowest in row crops, orchards, vineyards, rural residentials and oak savanna. Our analysis, however, showed that the highest adult:juvenile ratios were in grassland, oak savanna, and rural residentials, and the lowest in vineyards, orchards, other forage (chiefly hay), and rice (Figure 2). Thus, our data did not support the exclusion hypothesis.

The year-round data from the Le Grand transect (of which 80% is grassland or oak savanna) showed very few juveniles (Figure 3) during the winter. Most juveniles were observed from April through July. This juvenile abundance pattern is consistent with these birds being locally fledged. In the Central Valley, fledglings are seen as early as late April to early May, and their numbers peak from late May into early July (Pandolfino and Douglas 2021). The Le Grand data showed those juveniles were largely gone by August, before the bulk of the wintering adults arrived. This pattern is consistent with the observations that juvenile Red-tailed Hawks, similar to many other raptor species, usually migrate earlier than adults (Newton 1979, Hull et al. 2009, Preston and Beane 2024).

Of particular note is that the three land cover types with the highest ratios of adults to juvenile Red-tailed Hawks were also those most likely to support breeding adults (open to semi-open areas with tall trees for nesting; Preston and Beane 2024). Most of the grasslands in our area included at least a few scattered trees, and the areas characterized as rural residentials consisted mostly of small ranches, where trees are also a common element. Other land covers (e.g., row crops, vineyards, orchards, and rice) usually lack trees large enough to host nesting Red-tailed Hawks. In winter, the tree requirement does not exist, and this allows Red-tailed Hawks to exploit other cover types.

Given that most authors believe that breeding Red-tailed Hawks in our area are largely year-round residents (Fitch et al. 1946, Grinnell and Miller 1944, Preston 2000, Preston and Beane 2024), the following hypothesis plausibly explains our findings. As juvenile Red-tailed Hawks disperse in July

and August looking for suitable wintering areas, they will find that much of the grassland, savanna, and rural residential land covers are occupied by resident pairs of adults. Rather than compete for these occupied areas, juveniles may move into other areas with land covers where migratory adult Red-tailed Hawks have not yet arrived. Thus, the observed distribution of juveniles among these habitats would not need to involve active exclusion of juveniles by adults. This is consistent with the observations of others (Craighead and Craighead 1956, Gates 1972, Preston and Beane 2024) that intraspecific aggression in winter is quite rare among Red-tailed Hawks. Lowe (1978) noted instances of wintering adults in Oklahoma driving juveniles from their territories; however, in most reported cases of intraspecific aggression, there is no indication that adults are the primary initiators (Ballam 1984, Preston and Beane 2024). This hypothesis is further supported by the short-distance natal dispersal of juveniles in at least one California location (Briggs et al. 2020). Therefore, early, short-distance movement from their breeding location would give these juveniles ample opportunity to locate promising habitats before most migratory adults have arrived.

This hypothesis could be tested by observing Red-tailed Hawks from late summer into winter in high-quality Red-tailed Hawk wintering land covers such as rice, noting relative abundance by age and any instances of intraspecific aggression. Our hypothesis would predict that: 1) adult Red-tailed Hawks would be largely absent in July and August; 2) juveniles would begin arriving in late summer; and 3) there would be few examples of intraspecific aggression that resulted in exclusion of juveniles.

It is also possible that the differences in land cover associations we observed are the result of juveniles selecting cover types that offer easier access to prey or prey types that are easier for less experienced birds to obtain. Testing this hypothesis would require detailed studies of hunting success rates, types of prey consumed, prey abundance, and over-winter survival in a variety of land covers.

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Red-tailed Hawks (*Buteo jamaicensis*). 30 November 2021. Sacramento National Wildlife Refuge, Glenn County, California.

*Photo by Liam Huber.*