Dynamics of an Urban Turkey Vulture Roost in Sacramento, California

Daniel A. Airola, 2700 6th Ave., Sacramento, CA, 95818

The Turkey Vulture (*Catharus aura*) is common and widespread in much of California and the West. The Central Valley and surrounding foothills apparently host both a resident, year-round population and migrants moving to and from breeding and wintering areas elsewhere (Kirk and Mossman 1998). Large scale migration has been documented in the fall in the southern Sierra Nevada (Rowe and Gallion 1996, http://www.natureali.org/TV_daily_Stats.htm), Tehachapi Mountains (Moore and Moore, no date), and Mojave Desert (Rosenberg et al. 1991), and was reported recently in the central Sierra Nevada (D. Ross, pers. comm.).

Both resident and migrant Turkey Vultures make extensive use of communal roosting sites, but roost use patterns, roost site characteristics, and ecology in non-breeding areas have not been well-documented (Kirk and Mossman 1998, Evans and Sordahl 2009). Vultures populations also have been suggested as indicators of environmental health, based on sensitivity to pesticides and lead contamination (Kirk and Mossman 1998).

Observation of a Turkey Vulture roost site in urban Sacramento provided an opportunity to document numbers, patterns of use, roost habitat characteristics, and local movements to and from the roost.

STUDY AREA

I studied Turkey Vultures at a roosting area in and adjacent to William Land Park (hereafter Land Park), in Sacramento, California. The 67-ha park was established in 1926 and supports many large, old ornamental trees. The roosting site consists of two subareas on the north side of the park along 11th and 13th Avenues, and extends into the adjacent older Land Park residential neighborhood. The main use area at 13th Avenue encompasses about 26 ha. The 11th Avenue use area encompasses 4.5 ha and is separated by 250 m from the 13th Avenue roost. Overstory trees in both roost areas include: Deodora cedar (*Cedrus deodara*), Atlas cedar (*Cedrus atlantica*), Italian stone pine (*Pinus pinea*); London plane (*Plantanus acerifolia*); coast redwood (*Sequoia sempervirens*), red-gum eucalyptus (*Eucalyptus camaldulensis*), and other species. Areas beneath roost trees include including a popular walking trail, roads, and residential yards. The 13th Avenue area also includes a pond and borders a golf course.

METHODS

I conducted 99 systematic counts of all used areas over a 16 month period (26 September 2009 through 29 January 2011). I conducted surveys at 2 to 15 day intervals, with 4-8 surveys per month, except during September to November 2010, the period of peak fall migration (see Results), when 9-11 monthly surveys were conducted. I conducted most surveys during early morning hours (within 0.5-1.5 hrs of sunrise) when light was sufficient for viewing but before vultures began daily departure from the roost area. Several counts were conducted in the evening after vultures returned to the roost. I generally timed surveys to occur after most birds had left denser night roosting trees for morning post-roosting perches used to warm up before roost area departure (Evans and Sordahl 2009). I also conducted ten earlier morning and late evening surveys to document areas used for night roosting.

I counted vultures over a 30-70 minute period (depending on numbers of birds present) while walking a regular meandering transect that allowed viewing of all trees in areas where use had been observed. Vultures were relatively easy to view in winter when deciduous foliage was absent and they sought open areas exposed to the sun to warm up. During spring through fall, I likely missed a small number (estimated at no more than 15%) whose visibility was obstructed by denser foliage. I discontinued surveys and did not incorporate several counts when vultures were leaving the roost when I arrived or began leaving in large numbers before I completed counts.

I counted identifiable vultures in two general age classes based on head and bill color (Kirk and Mossman 1998): adult (after third year [ATY]) and subadult (<ATY) during August-November 2010. I also searched for individuals that had been marked in studies conducted elsewhere in the species' range. I also surveyed areas beneath roost trees and in adjacent areas for obviously ill or dead vultures, or signs of predation on vultures.

During 10 visits, I observed the timing, direction, and number of vultures departing from the roosting areas. I also recorded any reactions to human activities near roosting areas. I estimated distances from the roost site to potential foraging areas (areas of pasture and open grassland used for livestock grazing) using Google Earth (www.earth.google.com).

I recorded the number of night roost and post-roost trees of each species used during 78 visits. I distinguished night roosts from post-roosting trees by vulture presence during early morning sample periods, observed movements to post-roosting trees, and accumulations of feces. I measured tree diameters at breast height (dbh) using a diameter measuring tape.

I calculated estimates of the total number of different individuals that may be using the Land Park roost site annually during fall migration using two methods based on: 1) a 5-month period (mid-July – mid December) when abundance was higher than at other seasons at Land Park, and 2) the 30-day period of peak abundance, which corresponds to the general duration of migration passage at other California monitoring sites (i.e., Rowe and Gallion [1998] for the Kern

period of peak abundance, which corresponds to the general duration of migration passage at other California monitoring sites (i.e., Rowe and Gallion [1998] for the Kern River Valley, and Moore and Moore [no date] for Tehachapi Mountains). For both estimates, I subtracted the assumed average resident population of 40 (i.e., the average number during January-June). I then multiplied each total by 0.9, based on findings from the eastern U. S. that vultures migrate on an average of 90% of days (Mandel et al. 2008).

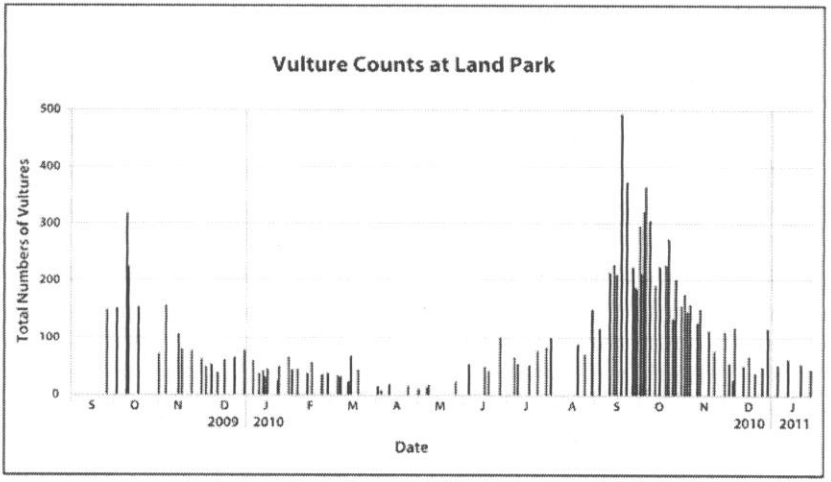

Figure 1. Numbers of Turkey Vultures counted at the roost site in William Land Park, Sacramento, September 2009 to January 2011.

RESULTS

Seasonal Abundance

Turkey Vultures occupied the roost site year-round. Numbers showed a strongly seasonal pattern of use, with monthly averages of 39-64 during December through March and 10-15 during April and May. Monthly averages gradual increased from 60 during June to 177 in September and peaked in October at 211 and 200 individuals in 2009 and 2010, respectively. Numbers then declined in November to averages of 97 and 131 in 2009 and 2010, respectively (Figure 1). The highest annual counts were 317 on 10 October in 2010 and 493 on 19 September in 2010. Totals exceeded 300 individuals on four other subsequent days through 9 October in 2010 (Figure 1). Notably, vulture numbers at the roost showed no increase during late winter and spring (Figure 1) when northward migration occurs. Also, not surprisingly numbers were low during late March to mid-June, presumably when local pairs were breeding away from the roost site.

vultures (84% of 9,965 vultures recorded on various dates) over the entire study period. Nearly all (>99%) of vultures at the 11th Avenue site were counted during August through October when the total roosting population was highest (Figure 1).

Daily vulture numbers fluctuated substantially during the presumed non-migratory period, with numbers on consecutive counts often varying by 30-50%. Most vultures were ATY age-class (94% of 1,350 vultures identified to age class).

I observed two different marked vultures, one each on 30 September and 2 October 2010, which had been trapped and marked in Orick, Humboldt County, California, 375 km northwest of Land Park, on 4 and 10 August 2009 (C. West, pers. comm.). These birds presumably had migrated to and from wintering areas to the south in 2009-2010, north to breeding areas in 2010, and were traveling south again. The co-occurrence of these two birds within 3 and 6 days of each other at two distant locations suggests coincident timing of migration.

Habitat Use and Behavior

Vultures roosting in Land Park regularly used both night roosting and pre- and post-roosting trees (Davis 1979, Kirk and Mossman 1998), although some individuals remained at night-roosting trees in mornings until they departed the roost area. The 16 trees used for night roosting were clearly some of the largest trees present (average = 113 + 21.5 cm dbh), including 14 Eucalyptus trees that were used year-round at 13th Avenue and two London planes at 11th Avenue used during late summer and fall when they supported dense foliage.

Most vultures regularly used other trees near the night roost trees as morning post-roost and evening as pre-roost perches. These perches tended to be exposed tops of large conifers, dead tops of live trees, and exposed branches of deciduous species. While certain trees were regularly used, the individual trees used and numbers of vultures occupying them varied substantially from day to day. In total, vultures used 80 trees of 14 different species during mornings, with 2 to 56 individual trees used on different days. Most post-roost use occurred in Deodora cedar (31% of trees used), Eucalyptus (28%; especially those with dead branches near the top), London plane (17%), Italian stone pine (9%), coast redwood (7%), and Atlas cedar (5%).

Vultures showed typical kettling behavior (Rowe and Gallion 1998) when departing the roost area, often circling to at least 100-200 m height and then departing in a straight line to daytime destinations. Most departures occurred to the southeast toward southeastern Sacramento County and southwest toward southern Yolo County. Approximate distances from the roost to major areas of uncultivated grassland habitat, where most available foraging resources for resident individuals were presumed to occur, are at least 24 km to the southeast and 16 km to the southwest.

Vultures generally showed no response to the low-intensity human

activities beneath and adjacent to roosting trees, including use of a walking and running trail and golf course, the feeding of ducks in the pond, and my monitoring. A few vultures seen on the ground or in low tree perches were flushed by pedestrians and moved to higher tree perches nearby. On several occasions, loud activities (dumping landscape materials, leaf blowing) within 50 m of a roost tree flushed roosting vultures, but they quickly settled at other trees. I found neither dead vultures, individuals showing signs of illness, nor any evidence of predation on vultures.

DISCUSSION

Seasonal Abundance and Daily Use Patterns

The seasonal pattern of use of the roost site by Turkey Vultures and the presence of several birds marked far north of the site confirms that it is used both by migrants and by resident or wintering birds. Numbers increased rapidly in late August to early September and reached a peak population in mid-September through mid-October that was nearly 7 times higher than the average December-July population (averages of 279 and 42, respectively).

The pattern of peak occurrence in Sacramento from early September 2010 through late October is broader than the late September to early October peak migration period observed in the Southern Sierra Nevada (Rowe and Gallion 1998) and late September to mid-October peak in the Tehachapi Mountains (Moore and Moore, no date). The overlap of the peak migration periods between Sacramento and both the Kern River Valley 430 km southwest and Tehachapi Mountains 460 km south-southwest is not surprising, based on information documenting daily movements of 80-385 km per day by individual Turkey Vultures through the Central Valley (http://www.frg.org/hms/HMS_TV.htm) and elsewhere (Kirk and Mossman 1998, Mandel et al. 2008).

Little information exists on the sizes of Turkey Vulture roosts in California other than a report of a roost that supported up to 500 per day near Porterville (Rowe and Gallion 1998). Range-wide, Turkey Vulture roosts "typically contain <100 individuals, but counts of up to 300 individuals are not rare" (Kirk and Mossman 1998). By this scale the Sacramento roost appears to be moderately important.

The pattern of occupancy of the 13th and 11th Avenue subareas indicates that the former subarea was the core roost used during every survey night, while the latter site appears to be an "overflow" area used only during the August-October peak period when migrants swelled the roosting population. Substantial fluctuations in numbers during the presumed non-migratory period is consistent with results from satellite tracking, which has shown that individuals shift use among multiple areas over the course of the season.

Turkey Vultures movements in Land Park between afternoon pre-roosting, night roosting, and morning post-roosting trees are typical for the species (Davis 1979, Evans and Sordahl 2009). Vultures showed only moderate fidel-

ity for individual trees, as much shifting of numbers was evident on different survey days.

Importance to the Migratory Population

The total number of vultures using the Land Park roost site over the season is unknown, because no information exists on turnover rate (i.e., replacement of departing migrants by arriving migrants). Although the Land Park roost population held only 200-500 individuals on any date during peak fall migration, its cumulative use by individuals may be substantial. The total number of migrant vultures using the Land Park roost site over the fall migration season was calculated as 6,507 using numbers over the peak 30-day period of migration observed in other California studies, and 15,120 using numbers from the 5-month period when the roosting population exceeded the presumed resident population.

As a basis for characterizing the importance of the Land Park roost, counts of Turkey Vultures at a major fall migration concentration area at the Kern Valley in the Southern Sierra Nevada averaged 26,329 (+4,879) over 1994-2005 (Rowe and Gallion 1998, http://www.natureali.org/TV_daily_Stats.htm). Annual fall migration counts during 3 years in the Tehachapi Mountains south of the Central Valley averaged 35,671 vultures (Moore and Moore no date). Therefore, based on the two estimation methods used to estimate migrants at Land Park, the area may have hosted roughly 18-60% of the number passing through each of these concentration areas. Peak nightly use of the Land Park roost by presumed migrant Turkey Vultures, however, was lower at nearly 500 (roughly 10%) of peak daily passages of more than 4,500 vulture in the Kern area and over 5,200 in the Tehachapis.

Possible Reasons for Use of an Urban Park Site

The question of why Turkey Vultures have selected the urban Land Park for roosting can be addressed at several scales. From a landscape perspective, the site is on a major migratory pathway, presumably because the hot climate and flat terrain of the Central Valley facilitates creation of thermals that allows efficient migration (Mandel et al. 2008).

The presence of a large number of tall trees likely encouraged Turkey Vultures' selection of Land Park as a roost, as vultures typically select tall trees (Kirk and Mossman 1998), presumably for security and to assist in arrival and departure. Turkey Vultures appear to select roost and post-roost trees within Land Park based on their size, insulation value, accessibility, and support for perching, consistent with other studies (Evans and Sordahl 2009). The fact that fewer trees were used for night roost than for post-roosting suggests that night roost trees may be more important for site selection. Alternatively, however, use of many more trees during post-roosting may suggest a need for birds to disperse to more trees to locate favorable positions for solar warming. There-

fore, the presence of more trees in the roost area to accommodate the pre- and post-roosting birds could be important in site selection.

Human disturbance at the site is relatively low, with only occasional mild human disturbance observed. It is doubtful that disturbance of the typically small roosts in rural areas (<300 birds; Kirk and Mossman 1998) has contributed to urban roosting by vultures, unlike a similar phenomenon suggested for much larger crow roosts (Gorenzel and Salmon 1992). Vulture use in the Land Park area creates only minor nuisance conflicts with neighbors (i.e., the mess due to feces and regurgitated pellets) only during peak migration season.

Why resident Turkey Vultures travel so far from the nearest suitable rural foraging areas to roost in an urban area, instead of roosting locally near foraging habitats, is particularly intriguing. The Land Park site and adjacent residential areas with extensive turf and ornamental plantings does not seem to trap heat that would reduce thermoregulatory energy load during cool time of year, as documented at sites with extensive paving, concrete, and buildings used by roosting crows (Gorenzel and Salmon 1995). Also, the vegetated conditions at the Land Park roost area also would not suggest advantages in producing early morning thermals to increase available time for foraging or migration movements. Perhaps given the relatively low energetic cost to vultures of long-distance flights, seemingly minor advantages of lower predation risk at an urban park site make it worth travelling to as a nightly roost.

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