

Southern Migration of Turkey Vultures through the Central Sierra Nevada Foothills, California, in 2015: Results of a Pilot Study

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"These birds usually come and go singly or in small flocks, but I once witnessed (October 1906) about 200 birds in five separate flocks flying westward over Clipper Gap. The largest flock contained 62 birds. I have seen 20 to 25 roosting together in the Yellow Pines."

Notation on the Turkey Vulture in *Land Birds of Placer County* by H.E. Adams (1909).

Adams' (1909) early description documents apparent migratory movements and roosting by Turkey Vultures (*Cathartes aura*), suggesting that these activities have been occurring in the Sierra Nevada foothills of Placer County, California for over 100 years. Nonetheless, the activities have not been subsequently described or quantified. Here, we provide results of a pilot study to document the Turkey Vulture migration timing and numbers, and roosting activity, in the Sierra foothills near Auburn, California.

Two of the three recognized subspecies of Turkey Vulture in North America migrate regularly. As noted by Bildstein (2008):

"...the eastern North American subspecies C.a. septentrionalis is a partial, intermediate-distance, leapfrog migrant whose northern populations move to winter into Mexico and the southeastern United States. In western North America, C.a. meridionalis is a mostly complete, long-distance, trans-equatorial migrant, most of whose northern populations overwinter in Central and South America."

Breeding populations of Turkey Vultures in the Central Sierra Nevada foothills and nearby regions are considered resident (Airola 2011, Beedy and Pandolfino 2013). The highly migratory northern breeding populations however conduct an impressive fall migration through the west side of the Sierra, which may "comprise a major vulture migration route" (Beedy and Pandolfino 2013). As raptor migration authority Keith Bildstein (2008) describes it,

"Migration begins in Coastal British Columbia and in Washington State, where more than a thousand Canadian breeders travel across the 20-km Strait of Juan de Fuca from the southern tip of Vancouver

Island in British Columbia to make landfall in northwestern Washington. Several weeks later, and approximately 1600-km farther south, the incipient torrent has built to 30,000 individuals at the southern tip of the Sierra Nevada."

In 2006, Bildstein and other scientists working for the Hawk Mountain Sanctuary initiated the Turkey Vulture Migration Project (http://www.vulturemovements.org/hms/HMS_TV.htm) to better understand the movement ecology of Turkey Vultures and to provide educational opportunities for students. As a result of this project's telemetry studies and regional work done by others (Rowe and Gallion 1996, Airola 2011, Moore and Moore 2014), we now have data that support earlier speculation of a concentrated traditional migratory route through the Central Valley and Central and Southern Sierra Nevada foothills.

Flight route maps from telemetry studies of the Turkey Vulture Migration Project show the species' southern migration flight path routes, as illustrated for 2006 to 2009 by the radio-tagged Vulture "Rosalie" (Figures 1 and 2).

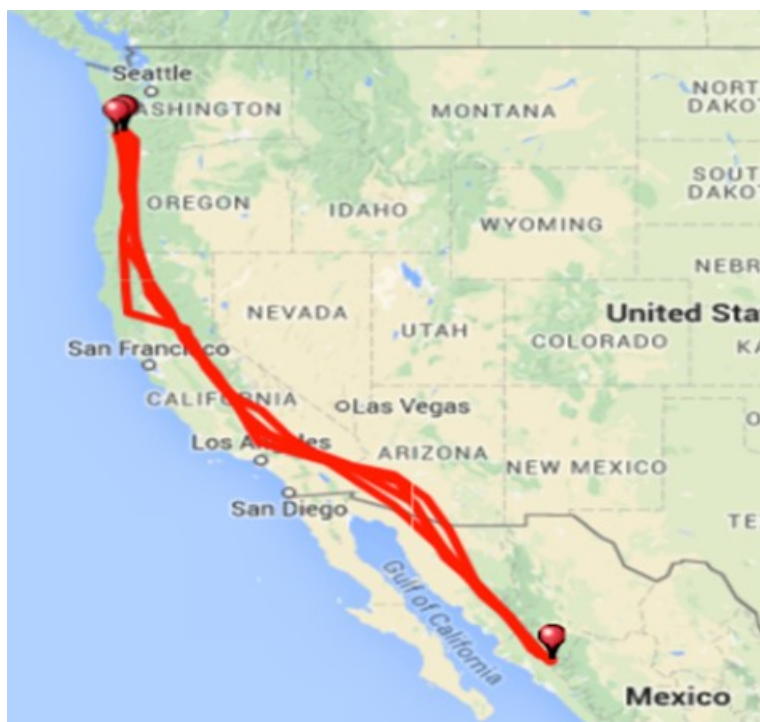


Figure 1. 2006-2009 southern migration of a Turkey Vulture "Rosalie" (PTT-57956). Note convergence of routes in the Central Sierra foothills. Reprinted courtesy of K.L. Bildstein, Turkey Vulture Migration Project.

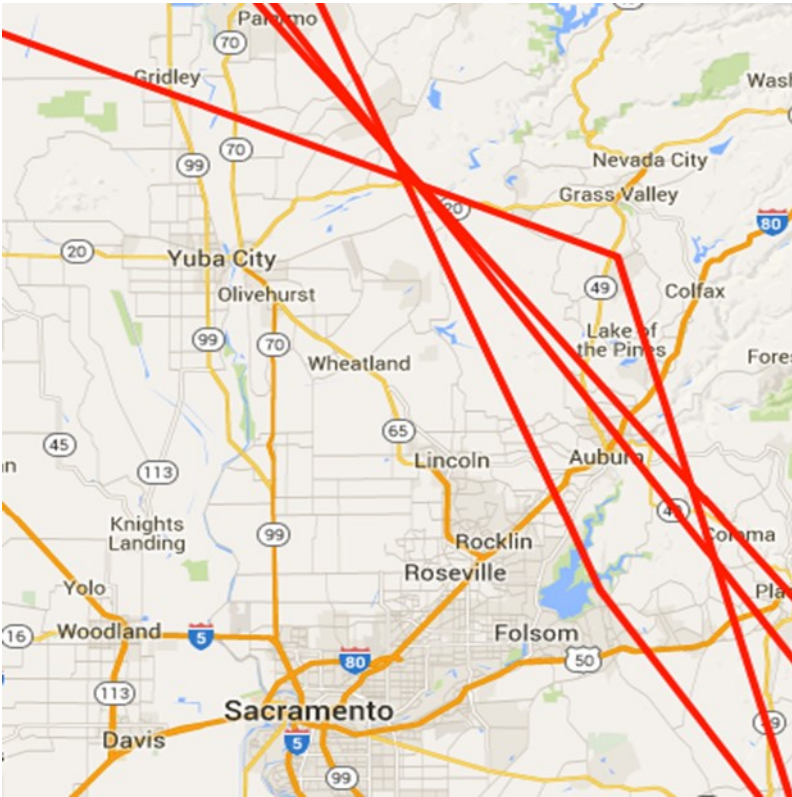


Figure 2. Expanded view of the Figure 1 map showing the Turkey Vulture “*Rosalie’s*” 2006–2009 route through the Auburn area. Reprinted courtesy of K.L. Bildstein, Turkey Vulture Migration Project.

Over the past 15 years, D. Ross and various observers in the Central Sierra Nevada foothills have reported large numbers of Turkey Vultures migrating through a relatively narrow region of western Nevada, Placer, and El Dorado counties. In recent years, the culmination of reports, telemetry studies, and other information has led to an increased awareness and interest in vulture migration.

In 2015, we and a group of volunteer collaborators established the first systematic effort to collect more information on the daily southern migration of Turkey Vultures through the Central Sierra Nevada foothills. The project purpose was to develop a better understanding of the local and regional migration and to share this information with others. Specifically, we sought to develop and test monitoring techniques, quantify abundance and timing of movements of vultures, and acquire information on use of roosting areas (stopover sites) in the Auburn area. This paper reports on the results of this pilot effort.

STUDY AREA

The count site is located on the northern rim of the North Fork American River canyon in Auburn, Placer County, California (Figure 3). It is locally known as “Headquarter Hill” (Lat. 38.888749, Long. -121.069812), which is located at the American Overlook Park on Pacific Avenue at 440 m elevation. The count site offers a broad view from which to locate approaching and passing migrants, as well as those departing from nearby roost areas (stopovers).

The overall viewing area encompasses the communities of Auburn, Christian Valley, Meadow Vista, Clipper Gap, and areas within the North Fork American River canyon in Placer and El Dorado County. The viewshed is characterized by steep canyons supporting pine-oak woodland, chaparral, and grasslands.

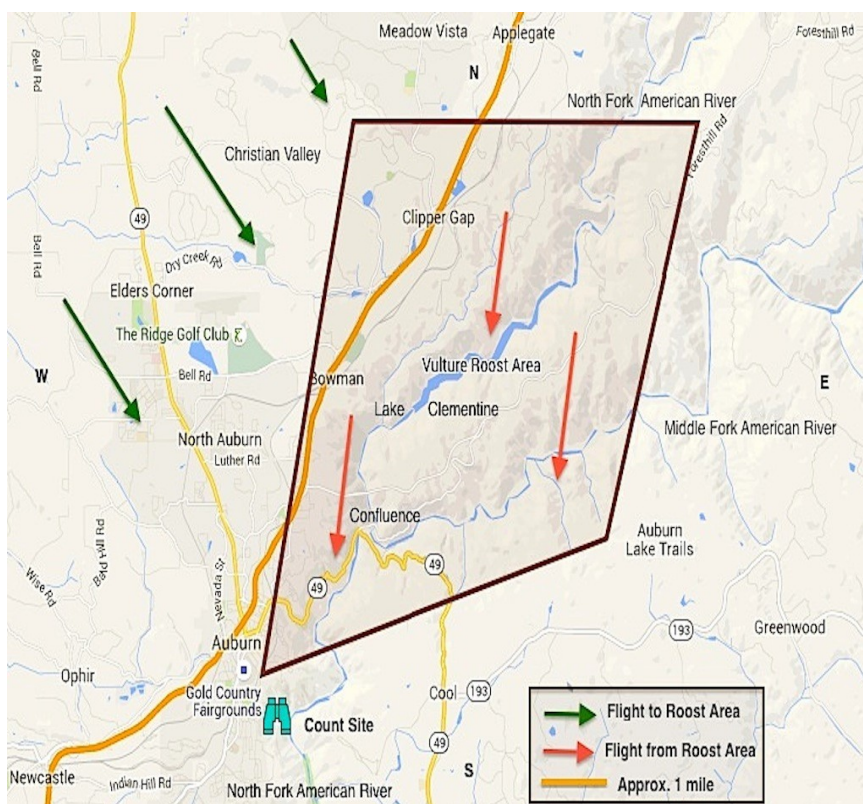


Figure 3. Study area vicinity showing major landmarks and general directions of travel by vultures in the central Sierra Nevada foothills, near Auburn California. Box encloses roosting areas.

METHODS

We selected the migration monitoring start date of 17 September based on the timing of previous observations (Ross, unpubl. data) and by adjusting from peak passage periods at other migration sites considered to be in the same general vulture migration flyway:

- Oregon: early Sept to early Oct (Kirk and Mossman 1998),
- Sacramento: mid-Sept to mid-Oct (Airola 2011),
- Southern Sierra Nevada: late Sept to early Oct (Rowe and Gallion 1996), and
- Tehachapi Mountains: late Sept to early Oct (Moore and Moore 2014).

Observers were experienced bird counters instructed in vulture counting methods and supervised during counts. Two to six observers per day conducted counts from 09:30 to 11:30 PST on 21 of 22 consecutive days from 17 September to 9 October in 2015. The daily starting times for surveys were based on past observations of when vultures began flying in the morning. The 11:30 stop time was selected to encompass the period when most movements occurred, especially from departing roosting birds. Therefore, an undetermined number of additional birds that presumably passed over the site each day after 11:30 were not counted. The primary purpose of the count was to identify both the seasonal and daily peak movements through the Auburn area. In this respect, the effort was a success; however, we did not identify the total daily number of migrants. A more extensive count is needed to better assess daily and seasonal totals.

D. Ross coordinated with observers on an ongoing basis during counts to track vulture locations, activities, and numbers seen, to avoid double-counting. For tracking and counting, we used a method similar to that described by Rowe and Gallion (1996) for the southern Sierra Nevada:

“Vultures were first spotted in kettles [i.e., groups] forming to the north of the count site. We attempted to keep track of the kettles as they dispersed and reformed before counting them. Kettles were observed until individuals began to “break-out” and glide past the count site. Because vultures break out of kettles individually and in single file, it is often possible to obtain exact counts. When kettles drifted past the count site or when large numbers of individuals broke out simultaneously, passing in a broad front, we estimated in groups of (five) to ten.”

We counted large kettles by groups of 20-40. In addition to observing departures, we regularly scanned for vultures passing high overhead. Vultures were typically observed in three formations: kettles, broad fronts, and high trails, the latter of which can be easily missed. Migrants in the foreground (i.e., within 3-5 km) were easily detected with binoculars (8x40

and 10x42) but spotting scopes were used to locate migrants at greater distances. We used natural and human landmarks to describe locations to other observers and record movement directions.

Data and observations recorded for vultures were: numbers, source (from roost areas or in transit overhead), height range, and the direction of flight. Counts of individuals were reconciled during and at the end of the count.

RESULT AND DISCUSSION

Migrant Numbers and Flight Direction

The highest numbers of Turkey Vultures (>90% of total observations) were seen daily between 10:00 and 11:00 am, as birds left the roosting area in the American River Canyon (see below).

Roost Characteristics and Use

During the 2-hour daily surveys over the 21-day period, observers counted 17,097 migrating Turkey Vultures, for an average of 814 vultures per day (=407/hr). Ninety-five percent of the total were seen over the 16-day period from 21 September to 7 October. The highest count occurred on 30 September, after a cold storm front passed, when approximately 3,000 vultures passed over within a 2-hour period (Figure 4). The overall pattern of abundance shows a longer period of lower numbers early, followed by a peak and then a rapid decline. The peak period for movements, with >1,000 vultures per day on 6 of 8 count days, was from 29 September to 10 October (Figure 3). The median date of passage (i.e., the time by when half of all recorded birds had passed) was 30 September. The timing of peak vulture movement in Auburn corresponds very closely to the peaks observed in urban Sacramento (Airola 2011), the southern Sierra Nevada, CA (Rowe and Gallion 1996), and the Tehachapi area (Moore and Moore 2014).

The count of 17,097 vultures passing through the central Sierra Foothills during a fall survey of limited daily and seasonal duration indicates that substantially more migrants are likely using this route. While data are lacking on numbers of vulture that migrate through the foothills outside of our survey periods, based on daily and seasonal patterns observed at other sites, it would not be surprising if future surveys detect as many as 30,000-50,000 individuals annually passing seasonally.

Our partial count of 17,097 vultures in the central Sierra foothills is within the general range of annual average numbers recorded or estimated at other vulture migrant concentration sites, where more extensive seasonal counts have been made, including:

- 26,329 during 1994-2005 in the Kern Valley of the Southern Sierra Nevada (Rowe and Gallion 1996, http://www.natureali.org/bird_articles/TV_daily_Stats.htm),

- 35,671 during 2000-2003 in the Tehachapi Mountains at the south end of the Central Valley (Moore and Moore 2014),
- 15,120 individuals using a Sacramento roost over an extended five month period of apparent migration (Airola 2011), and
- 8,865 at the Marin Headlands (Sawtelle and Fish 2012).

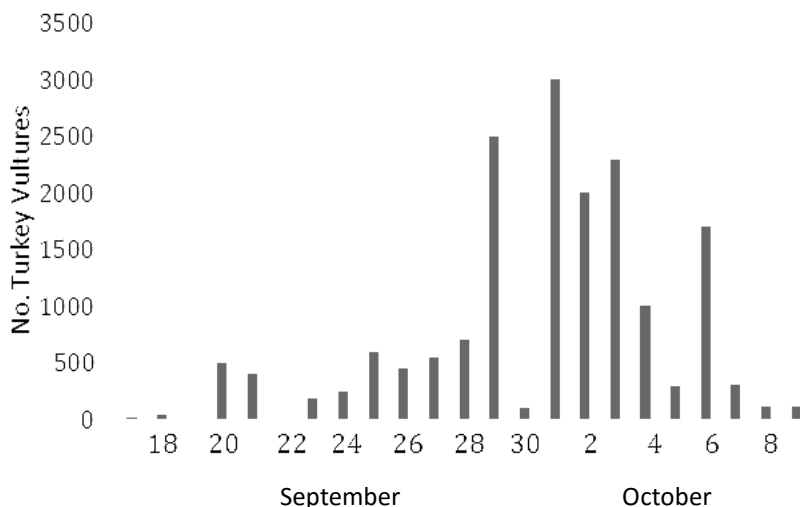


Figure 4. Counts of Turkey Vultures at Auburn, California observation site, 17 September to 9 October 2015.

Migrants typically approached from the northwest, between North Auburn and Meadow Vista. After passing over the Auburn region, the vast majority traveled directly south toward Pilot Hill and Folsom Lake. Observed evening roost areas (stopovers) were located between Auburn and Meadow Vista, primarily south of I-80, and east into the North Fork American River Canyon (Figure 3).

Roost Characteristics and Use

Areas occupied by roosting Turkey Vultures extended over about 4.9 km² (10-15 mi²) along the North Fork American River Canyon between Auburn and Applegate (Figure 3). Nearly 80% of the daily migrants we observed departed from the roost area. Departures from the roost area typically began between 10:00 and 10:30 AM. Presumably this timing coincided with development of thermal updrafts that Turkey Vultures rely on for migration (Campbell 2015). On peak days, several hundred vultures rose nearly simultaneously before heading south. The rapid rise and dispersal over a short period each day may explain why these large migratory events have previously gone largely unreported, except by Adams (1909).

Kettles ranged between 20 and 300 birds and averaged 75 to 100. Multiple large kettles with over 200 birds were observed during the last week of September and the first week of October.



Figure 5. Approximately 120 Turkey Vultures, part of a larger flock migrating over Lake Clementine on the North Fork American River, Placer County, CA. 2 October 2015.

Photo by Dennis Cavallo

Possible reasons why Turkey Vultures select the pine-oak woodlands in the foothills and American River canyon for roosting may include the abundance of tall trees for roosting (Airola 2011), excellent sources of thermal updrafts, orographic lift for dispersal, year-round water, and an abundance of domestic and wild animals as potential food sources. The resident Turkey Vulture population also may have served as a guide to the roosting areas for migratory birds, although vultures are long-lived (Kirk and Mossman 1998) and so may remember routes and traditional stopping areas over their lifespan.

Effects of Weather on Migration

Weather conditions overall during survey periods were generally similar over the count period, with mild temperatures between 18° and 24°C (65 and 75° F), light winds, and partly cloudy to sunny skies. The one exception was the fast-moving storm system that passed through on 30 September, shortly after which the highest daily numbers of birds, 3,000 (17.5% of the total migrants recorded), were counted moving through the area.

Higher rates of movement by Turkey Vultures after weather fronts also have been noted in the Tehachapi Mountains (Moore and Moore 2014) and other count sites (Allen et al. 1996). The higher passage rate after the front may have resulted from accumulations of migrants to the north that could not move through the front due to unfavorable flight-weather conditions (Smith 1985) or perhaps the creation of highly favorable conditions for movement as the end of the front passed (Miller et al. 2011). Vulture responses to weather conditions probably depend on local effects on wind direction in relation to migration route (Allen et al. 1996, Gettig and Hawkins 2012) and effects of storms on creation of thermals that vultures frequently use during migration through the study area. Future recording of detailed weather data may help to explain the localized effects of weather on migration passage.

Contributions to Knowledge of Western Turkey Vulture Migration

Knowledge of Turkey Vulture migration in California is largely based on telemetry studies of relatively few individuals by the Turkey Vulture Migration Project and from counts of migrating or roosting birds at scattered sites that have been identified as areas of migrant concentration. This previous work has identified areas of concentrated Turkey Vulture migration in the Central Valley (Airola 2011), Southern Sierra Nevada (Rowe and Gallion 1996), Tehachapi Mountains (Moore and Moore 2014) and the Central California coast (Sawtelle and Fish 2012). Our efforts identified the Central Sierra Nevada foothills as an additional part of a migration route and provided initial information on numbers of vultures using this area during fall migration. Much remains to be learned regarding the total number of vultures using the foothills during migration (i.e., at daily times and days outside of our limited 2015 survey period). We expect to contribute significantly to this knowledge in subsequent years (see below).

Substantial information also is needed to understand the magnitude of vulture migration in other areas of the state, and patterns of movements of birds between existing concentration sites. For example, are the same birds passing through the Central Sierra Foothills and the Southern Sierra Nevada and Tehachapi Mountains? Or are birds passing through the Tehachapi's a different set of birds that have migrated through the Central Valley and interior Coast Ranges?

Lessons Learned Regarding Study Methods

This survey was mainly a pilot project to test methods and feasibility of establishing a Turkey Vulture migration count. We consider the pilot study successful and plan to continue and expand the study in 2016. Dunn et al. (2008) have identified recommended criteria to qualify a monitoring program for use in regional and continental analyses of raptor migration:

"For a species to be well monitored, observations should be taken across most of the migration period, not only during peak passage (Lewis and Gould 2000). For a species to qualify for analysis, counts should be made on a minimum of 75% of the days during the species' migration "window" (the period during which 95% of migrants pass by that particular site). For species with migration windows less than one month, we recommend covering at least 20 days (preferably more) within the migration window."

In 2016 we intend to broaden the survey to establish well-defined, site-specific survey protocols to fully meet these criteria. The protocol is expected to incorporate the following elements:

- extend the daily survey period from 2 hours to at least 6 hours,
- extend seasonal coverage from 21 days to at least 30 days,
- systematically record other migrating species, particularly raptors, and
- record standard weather conditions (temperature, wind speed and direction, and cloud cover).

The success of future efforts will largely depend on a sufficient commitment of time by well-trained volunteers to collect data in a standardized and consistent manner.

Conservation Concerns and Significance

Conservation concerns regarding Turkey Vultures include their conservation value as an indicator of environmental health, potential conflicts with aviation, and potential for land use conflicts.

As a largely protected and ecologically beneficial species, Turkey Vultures have gained a greater appreciation and respect in the eyes of most people in recent years. Once thought to be harbingers of disease, we now know that vultures can function as an important early biological indicator for pollution, poisoning, and other toxic substances in the environment (Kirk and Mossman 1998, Campbell 2015). Therefore, seasonal vulture migration studies can serve as a basis to monitor long-term trends as an indicator of environmental quality.

The Auburn Airport is located within the southern migration flight path of Turkey Vultures and within 3.5 km of the Turkey Vulture roost area. An increase in vulture numbers during peak migration increases the potential for

vulture-aircraft collision hazards (M. Campbell, pers. comm.). To our knowledge, however, collisions have not been an issue at the Auburn Airport, despite presumed long-term use of the area as a roost area and airport. Acquiring better information on the timing and numbers of vulture during various daily and seasonal periods, and sharing this information with the local airport officials, could be important to maintain the safety of both humans and vultures. In particular, much of the potential for vulture-aircraft collisions is limited to the half hour morning period when vultures leave their roost areas.

We are not aware of local land use issues that would cause concerns over continued vulture migration and roosting. Much of the roost area and area crossed locally during vulture migration are protected within the Auburn State Recreation Area and Tahoe National Forest, and there are substantial other areas of open space dedicated to wildlife preservation and agricultural use. The count site is in a city park and is likely to continue to be protected because of its historical value, as a World War II memorial. Possibly recognition for its importance as a vulture migration viewing site also will encourage local officials to protect and preserve the area.

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LITERATURE CITED

Adams, E.H. 1909. Land Birds of Placer County. Placer County Institute Research.

Airola, D.A. 2011. Dynamics of an urban Turkey Vulture roost in Sacramento, California. Central Valley Bird Club Bulletin 14:1-8.

- Allen, P.E., L.J. Goodrich, and K.L. Bildstein. 1996. Within and among year effects of cold fronts on migrating raptors at Hawk Mountain, Pennsylvania, 1934-1991. *Auk* 113:329-228.
- Beedy, E.C. and E.R. Pandolfino. 2013. *Birds of the Sierra Nevada: Their Natural History, Status, and Distribution*. University of California Press, Berkeley, Los Angeles, and London.
- Bildstein, K.L. 2006. *Migrating Raptors of the World: Their Ecology and Conservation*. Cornell Press, Ithaca, New York.
- Bildstein, K.L., J.P. Smith, R.R. Veit, and E. Ruelas Inzunza. 2008. State of North America's Birds of Prey. Nuttall Ornithological Club, Cambridge, Massachusetts, and American Ornithologists' Union Washington, D. C., AOU Publications, Fayetteville, Arkansas.
- Campbell, M.O. 2015. *Vultures: Their Evolution, Ecology and Conservation*. CRC Press, Boca Raton, Florida.
- Dunn, E.H., D.J.T. Hussell, and E. Ruelas Inzunza. 2008. Recommended methods for population monitoring at raptor-migration watch sites. pg. 447-459 *in*: K.L. Bildstein, J.P. Smith, R.R. Veit, and E. Ruelas Inzunza. State of North America's Birds of Prey. Nuttall Ornithological Club, Cambridge, MA, and American Ornithologists' Union, Washington, D.C. AOU Publications, Fayetteville, AR.
- Gettig, T.E. and T.W. Hawkins. 2012. Weather influences on raptor migration along the Kittatinny Ridge, Pennsylvania. *Geographic Bulletin* 53:79-92.
- Kirk, D.A. and M.J. Mossman. 1998. Turkey Vulture (*Cathartes aura*), *in*: The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/339> doi:10.2173/bna.339. Accessed 22 Jan 2016.
- Lewis, S.A., and W.R. Gould. 2000. Survey effort effects on power to detect trends in raptor migration counts. *Wildlife Society Bulletin* 28:317-329.
- Miller, R.A., J.D. Carlisle, and G.S. Kaltenecker. 2011. Effects of regional cold fronts and localized weather phenomena on autumn migration of raptors and landbirds in the southwest Idaho. *Condor* 113:274-283.
- Moore, C.H. and J.E. Moore. 2014. Tehachapi Vulture Count. Kern Audubon Society Tehachapi Chapter, Tehachapi, CA. <http://www.tehachapibirds.org/projects/turkey-vulture-count.html>. Accessed 15 January 2016.
- Rowe, S.P. and T. Gallion. 1996. Fall migration of Turkey Vultures and raptors through the Southern Sierra Nevada, California. *Western Birds* 27:48-53.

Sawtelle, S. and A. Fish. 2012. Hawkwatch summary 2012. Pacific Raptor Report 34:14. <http://www.parksconservancy.org/assets/programs/ggro/pdfs/pacific-raptor-report-34.pdf>

Smith, N.G. 1985. Dynamics of the transisthmian migration of raptors between Central and South America. Pg. 271-290 in I. Newton and R. D. Chancellor, eds., Conservation Studies in Raptors. International Center for Birds of Prey Technical Bulletin No. 5.



Turkey Vulture (*Cathartes aura*). 16 November 13.
Sacramento County, CA. Photo © Dan Brown