Irruptions of the Band-tailed Pigeon, Lewis's Woodpecker, Steller's Jay and Varied Thrush during Winter 2014-15 in California's Central Valley

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Several non-breeding species occasionally occur in unusually large numbers in the Central Valley (CV) of California from fall through early spring. These irruptions often involve one or more boreal seed-eating birds such as, Red-breasted Nuthatch (*Sitta canadensis*), Pine Siskin (*Spinus pinus*), or Evening Grosbeak (*Coccothraustes vespertinus*) (Pandolfino 2012). Irruptions of these species is a well-known phenomenon throughout the northern hemisphere (Newton 2003), with two or more of these species often irrupting at the same time (Bock and Lepthien 1976, Koenig 2001). The CV also experiences frequent Fall-Winter irruptions of Lewis's Woodpeckers (*Melanerpes lewis*) and Varied Thrushes (*Ixoreus naevius*) (Pandolfino 2006). Irruptions of Band-tailed Pigeons (*Patagioenas fasciata*) and Steller's Jays (*Cyanocitta stelleri*) also occur, but much less frequently. From Fall 2014 through Winter 2014-15, CV rare bird listserves included many reports of unusually high numbers of Band-tailed Pigeons, Lewis's Woodpeckers, Steller's Jays, and Varied Thrushes. In order to quantify this phenomenon, and to put it into historical perspective, I analyzed data from eBird and Christmas Bird Counts (CBCs) for the CV and used these data to compare the abundances of these species during this period to prior seasons.

DATA SOURCES AND METHODS

I obtained CBC data from National Audubon Society (2010) and eBird data from eBird (2015). I used data from the 21 CV CBC circles that reported data for Count Year 115 (winter 2014-15) (Figure 1). CBC data were normalized for relative effort using the number of birds observed per party hour for each circle. I used eBird data from all validated checklists from the seven counties that lie entirely or mostly within the CV: Kings, Merced, Sacramento, San Joaquin, Stanislaus, Sutter, and Yolo counties. To compare this recent period to historical CBC results, I compared data from Count Year 115 to Count Years 79-114. For eBird, I compared data from August 2014 through May 2015 to data for the August-May period from August 2000 through May 2014. The eBird data were normalized by using the percentage of all checklists submitted that recorded each species.

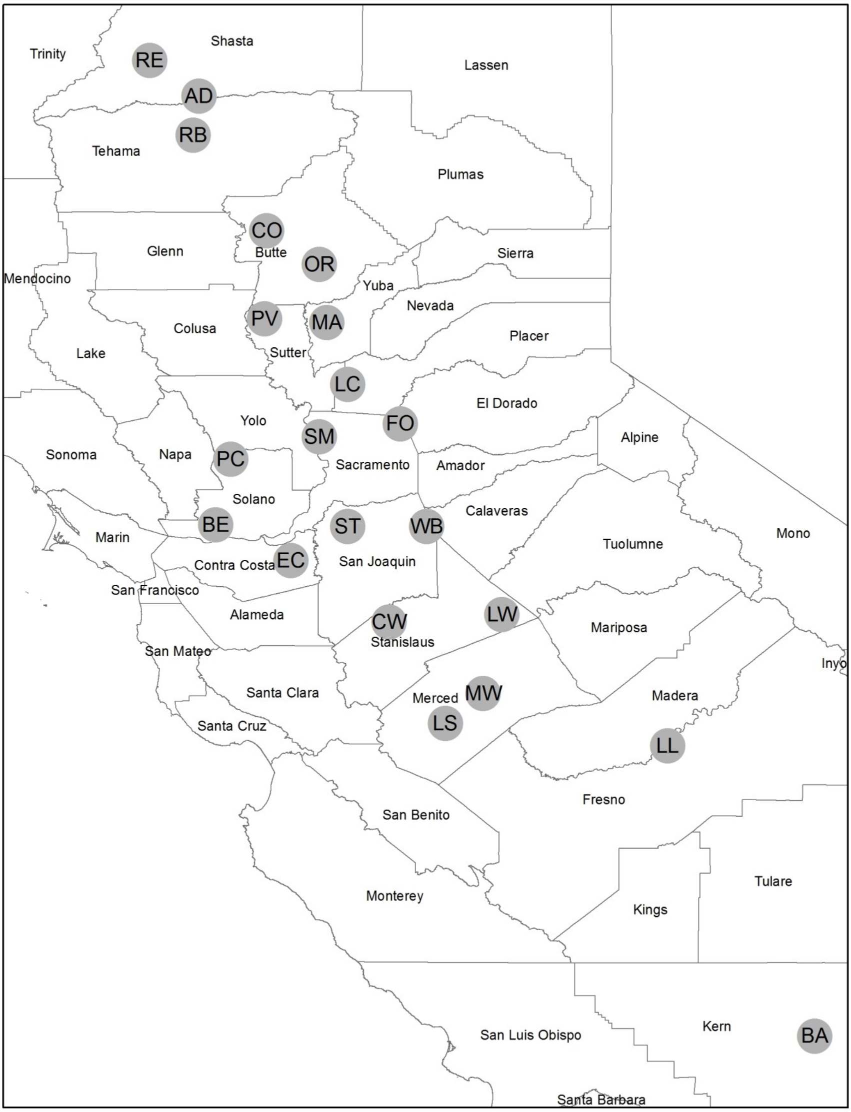

Figure 1. The 21 Central Valley CBC circles. Count circles are to scale. From north to south they are: Redding (RE), Anderson (AD), Red Bluff (RB), Chico (CO), Oroville (OR), Peace Valley (PV), Marysville (MA), Lincoln (LC), Folsom (FO), Sacramento (SM), Putah Creek (PC), Benicia (BE), Stockton (ST), Wallace-Bellota (WB), East Contra Costa (EC), Caswell-Westley (CW), La Grange-Waterford (LW), Merced NWR (MW), Los Banos (LS), Lost Lake-Fresno (LL), Milburn-Fresno (MF), and Bakersfield (BA).

RESULTS AND DISCUSSION

Timing and Location of the 2014-15 Irruptions

Data from eBird checklists (Figure 2) show the scale and timing of the 2014-15 irruptions. For each of these four species, the frequency of observations began to exceed historical averages in mid-fall and these high rates of observations continued into early spring. By early winter, each species was being reported at levels many times the historical average. For both Lewis's Woodpecker and Steller's Jay, the rate of observations peaked in late fall and gradually declined, returning to average rates by late April. The Varied Thrush's observation rates built quickly to a mid-winter peak and declined to normal levels by late March. Band-tailed Pigeon observations were highly variable, but consistently well above average until late April.

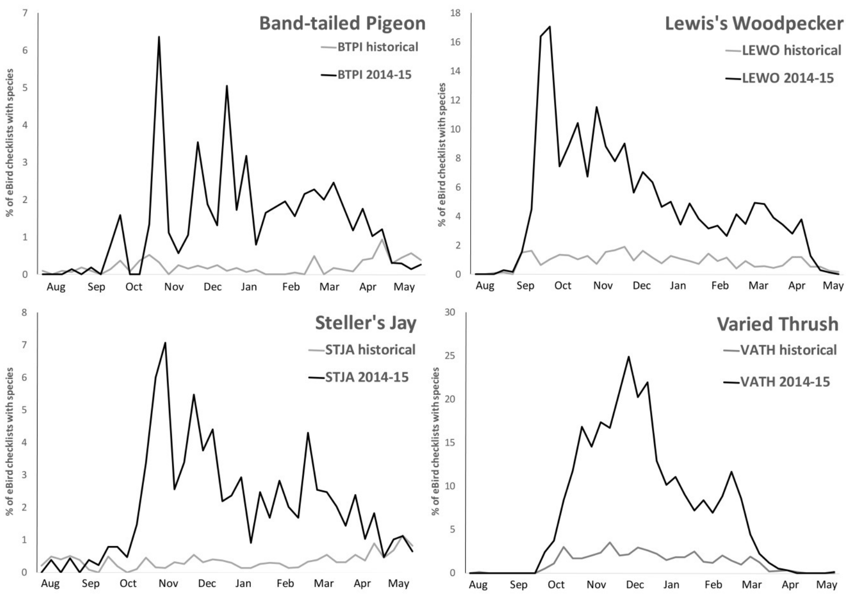

Figure 2. The percent of eBird Checklists reporting each species from fall 2014 through spring 2015 and from fall 2000 through spring 2014. These data are from the seven counties which lie entirely or mostly within the CV (see ***Data Sources and Methods***).

The irruption of Varied Thrush was the most widespread in the CV of the four species, with all but two circles reporting abundances more than double the average (Figure 3). Irruptions of the other three species appeared to be more restricted to the Sacramento Valley and the Sacramento/San Joaquin Delta. Irruptions of at least three of these species were noted outside the CV in California during this season (McCaskie and Garrett 2016a, 2016b; Pandolfino et al. 2016) with Varied Thrushes present in remarkable numbers throughout the state, unusually high abundance of Band-tailed Pigeons in coastal locations in Northern and Southern California, and above average counts of Lewis's Woodpeckers in the Coast Range as far south as Santa Clara County.

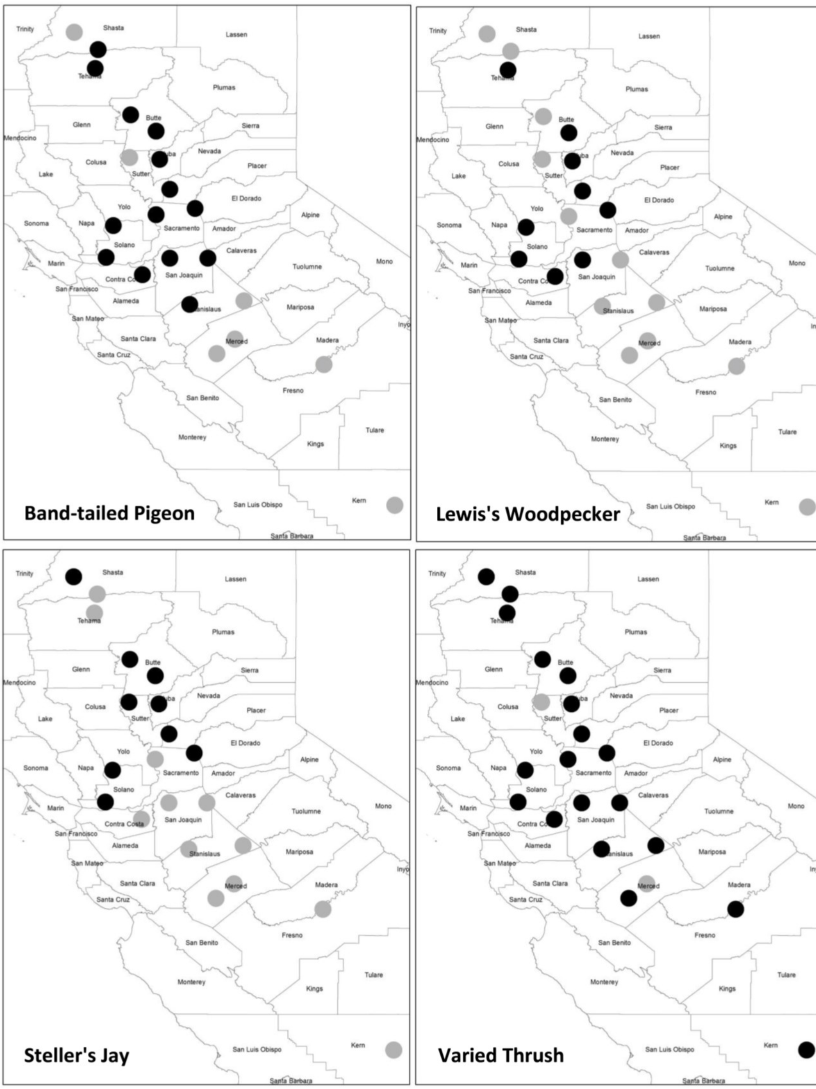

Figure 3. CV CBC circles that reported at least twice the long term average abundance of the species during winter 2014-15 (dark circles). Long term average is based on data from count year 79 (winter 1978-79) through count year 114 (winter 2013-14).

Historical Perspective

Data from CV CBC circles since 1978 allow placement of the magnitude of these irruptions into historical context (Figure 4). During winter 2014-15, Band-tailed Pigeons were at an abundance five times higher than the long-term average and at the second highest level over this period. Lewis's Woodpecker abundance set a new record and was nearly three times the long -term average. Steller's Jays were recorded at a level six times the average and twice the previous high. Varied Thrush abundance also set a new high and was eight times the long-term average. The magnitude of this year's irruption was exceptional, especially for Band-tailed Pigeon, Steller's Jay, and Varied Thrush (Figure 4).

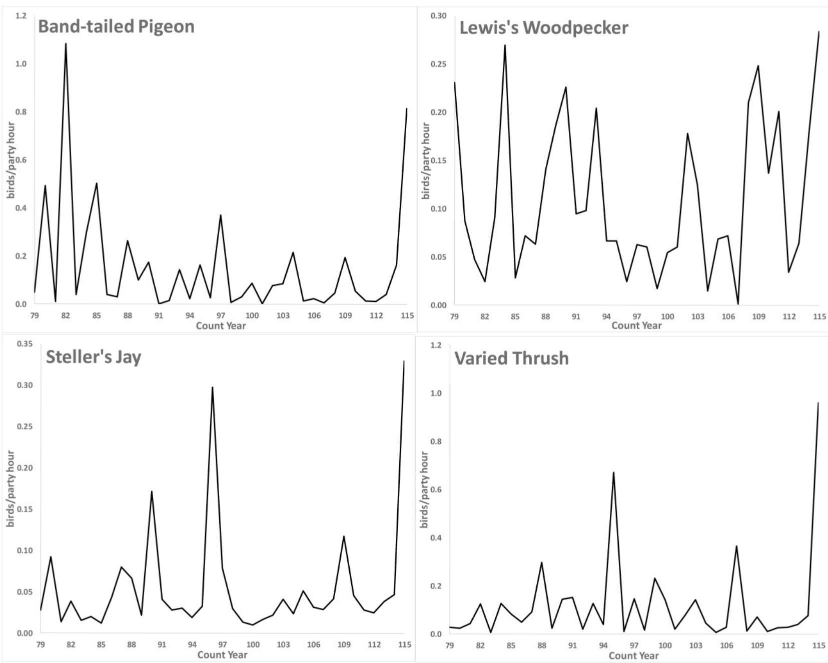

Figure 4. Average abundances of each species within CV CBC circles from count year 79 (winter 1978-79) through count year 115 (winter 2014-15).

It is also clear from CBC data that these four species have not irrupted in the same year during this period (Figure 5) until 2014-15. Irruptions of these four species showed no synchronicity at all, with the possible exception of Lewis's Woodpecker and Steller's Jay, where all three Steller's Jay irruptions occurred in years of high Lewis's Woodpecker abundance. Both the magnitude and the concurrence of these four irruptions make this an apparently unprecedented phenomenon in the CV.

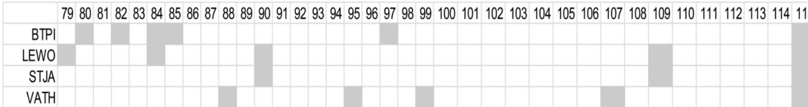

Figure 5. Years when average abundance was at least twice the long term average (shaded blocks) for CV CBCs. Long term average is based on data from count year 79 (winter 1978-79) through count year 114 (winter 2013-14). BTPI=Band-tailed Pigeon, LEWO=Lewis's Woodpecker, STJA=Steller's Jay, VATH=Varied Thrush.

Possible Causes

Speculation about the potential causes of avian irruptions is always difficult. Even for irruption phenomena that have been well-studied, the primary drivers remain controversial. The well-known broad-scale irruptions of boreal seed-eating species such as Red-breasted Nuthatch, Pine Siskin, and Evening Grosbeak have been correlated with years of poor seed production in the boreal forests (Bock and Lepthien 1976, Larson and Bock 1986, Koenig and Knops 2001). However, a recent analysis (Strong et al. 2015) found that a concurrence of climate conditions in the breeding regions and in the areas where irruptions occur is a more important factor (at least for Pine Siskin). For north-to-south irruptions, this involves a complex "push-pull" phenomenon whereby poor climate conditions in the north may "push" birds south and simultaneous good conditions in the south may "pull" birds in that direction. Even in the case of irruptions of Snowy Owls (*Bubo scandiacus*) into the northern U.S., which were thought to be driven by crashes in lemming (*Lemmus lemmus*) numbers in the arctic (Gross 1947), this single factor has not been confirmed as predictive of these irruptions (Holt et al. 2015).

Although occasional irruptive movements have been noted for all four of the species analyzed here, irruptions of these species has been studied very little. Of these species, only irruptions of Varied Thrush has been the subject of a detailed study (West et al. 1996). These authors noted a 2-3 year cycle in fluctuations of winter abundance within the normal winter range and speculated that acorn production, an important winter food source for this species (Luke 2000), may be important. However, West et al. (1996) did not find any correlation between these cyclic changes in abundance and notable irruptions beyond normal wintering locations (e.g. southern California, Midwest or eastern North America).

A major obstacle to identifying causes of these irruptions is our lack of knowledge about the source population from which these birds were drawn. Without knowing where these birds breed or normally winter, we are left to guess about any factors that may have driven large numbers to winter in the CV. Although Band-tailed Pigeons are found year-round along the California coast and in the Sierra, it is unknown if these populations are resident, if the winter populations are migrants from further north, or if wintering birds are a mix of residents and migrants. Therefore, the pigeons that staged this season's irruptions could have moved downslope from the Sierra, east from the coast, south from northwestern North America, or west from the Rockies or Great Basin (Slosson and Goss 1982, Keppie and Braun 2000).

Lewis's Woodpeckers are well-known for their large fluctuations in winter abundance in the CV (Pandolfino 2006) and elsewhere (Vierling et al. 2013), and the source of these irruptions may be from breeding populations in the Sierra, from California's coast range, and/or from the northernmost portions of their range (Grinnell and Miller 1944, Bock 1970). Large influxes, such as this season's, almost certainly involve birds from beyond the relatively small California breeding population.

Steller's Jays, which are mainly resident throughout their range, are known to make occasional altitudinal movements, probably in response to local food shortages, as well as rare longer distance irruptions (Walker et al. 2014). Band recovery data confirm these irruptions can involve birds moving hundreds of kilometers south of their breeding range (Hough 1949, Webb 1981). Garrett and Dunn (1981) noted irruptive Steller's Jays in the southern California deserts seemed to come mainly from the Great Basin.

Data from specimens suggest the Varied Thrushes that winter in the CV and southern California are <u>not</u> from the Pacific coastal-breeding subspecies (*I. n. naevius*) but are *I. n. meruloides* (Grinnell 1901), a subspecies that breeds from the interior of Alaska, south into northern Oregon and east to Montana. Based on review of a few photos (pers. obs.) and a single specimen (A. Engilis, pers. comm.), Varied Thrushes present in 2014-15 also seem to be of this interior subspecies.

In general, large scale fall-winter irruptions of birds can be driven by one or more of the following mechanisms: 1) poor conditions on their normal wintering areas pushing them to leave; 2) good conditions in the area where the irruptions occur causing migrating birds to concentrate there in large numbers; or 3) an usually productive breeding season that produces local overpopulations in normal wintering areas that forces a wider than normal dispersal of young-of-the-year. Given the huge geography from which the birds responsible for this season's irruption may have come, it is difficult to speculate on conditions which may have pushed them away from normal wintering areas to the CV.

The 2014-15 winter was one period in a long-term drought in the Sierra Nevada and much of the Intermountain West, with associated large scale forest fires. Many of these irrupting birds, however, may have come from northwestern North America where these same conditions did not exist. Also, warm and dry conditions are certainly not unique to the 2014-15 winter. The normal ranges of all four species fall entirely within western North America. 2014 was an exceptionally warm year in the west. Temperatures from April through August were well above average in every portion of western North America (https://www.ncdc.noaa.gov/) and that year was the warmest ever recorded for the region as a whole (http://climatenexus.org/2014-putting-hottest-year-ever-perspective). While one can imagine that conditions such as reduced food supply created by this unprecedented warmth could have driven birds to make unusual movements, it is unclear why so many would have moved into the CV and other areas of California.

In the absence of enough data to identify factors that may have pushed birds away from traditional wintering grounds, I considered local factors that may have attracted them to the CV and other parts of California. One intriguing factor to consider is the level of acorn production. Acorns are recognized as an important winter food source for all four of these species (Keppie and Braun 2000, Luke 2000, Vierling et al. 2013, Walker et al. 2014). It is also well known that most oaks in California display a "boom and bust" cycle of acorn production, with few acorns produced in some years and an over-abundance in others (Koenig et al. 1994). This is an ideal strategy for a plant whose main seed disperser (e.g., Western Scrub-Jay, *Aphelocoma californica*) also consumes the seeds. Occasional overproduction of seed insures more acorns will be cached (shallowly buried in various spots) than can be consumed (Grinnell 1936). Three species are the key acorn producers in the CV, valley oak (*Quercus lobata*), blue oak (*Quercus douglasii*), and interior live oak (*Quercus wislizeni*) and acorn production by these species has been monitored through the California Acorn Survey (http://www.nbb.cornell.edu/wkoenig/wicker/CalAcornSurvey.html) since 1994. These data show that the acorn crop in fall 2014 was among the lowest recorded for interior live oak, fair to poor for blue oak, but fairly good for valley oak (Koenig 2014). Thus, any role for acorn abundance in California as a driver of this irruption is uncertain.

It seems certain that actual causes of this season's irruptions will remain a mystery. While it is interesting to speculate about the simultaneous irruption of all four species in a single year, it may be that few, if any, drivers are shared among these species' irruptions.

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