POPULATION TRENDS OF COLUMBIDAE ON THE ALBUQUERQUE CHRISTMAS BIRD COUNT

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INTRODUCTION

The annual Christmas Bird Count (CBC) is the longest-running citizen science project relating to counting wild birds in the Western Hemisphere (Dunn et al. 2005). The Albuquerque CBC is the longest running one in New Mexico; the first one was held in 1902, not long after the initial establishment of the CBC in 1900; was held again in the years from 1935 to 1939; 1947; and then annually since 1961 (with the exception of 1970). These over 60 years of CBC data provide invaluable insights into the status and trends of birds in early winter across the country and in the Albuquerque area; these data have been used in many publications (see Dunn et al. 2005, www.audubon.org/christmas-bird-count-bibliography).

The species of the family Columbidae are well suited for analysis as they are generally easily seen, identified, and counted during the CBC and have shown well documented changes in populations over time in response to changes in habitat, urbanization, and climate in areas in which they occur. Furthermore, several species have either been introduced into the United States during the time period of the CBC and/or have well documented range expansions, such as Eurasian Collared-Dove (*Streptopelia decaocto*) and White-winged Dove (*Zenaida asiatica*). In this paper, I summarize the species of Columbidae found on the Albuquerque CBC between 1961 and 2019; document their changes in population status and trends over time; and explore the effects of the introduction of new species of Columbidae into the Albuquerque avifauna on existing and native Columbidae.

METHODS

CBC methodology is well-documented elsewhere and is summarized here (see www.audubon.org/conservation/science/christmas-bird-count). The Albuquerque CBC is located in Bernalillo and Sandoval Counties, New Mexico, and consists of a 15-mile diameter circle centered at coordinates N 35.18°, W 106.62° (in the North Valley on 2nd Street between Alameda Blvd and Ortega Rd NW). The goal of any CBC is to count as many individual birds of as many species as possible in a 24-hour period on one calendar day. The count is conducted during the annual "Christmas count period" which is currently designated as December 14 of a year to the following January 5. Therefore, although the annual count could actually occur in one of two months in consecutive calendar years, the count year used in this paper is referred to by the year of December of that count period. Species recorded during the three days before and after the actual

count day are recorded as occurring during "count week;" those species are recorded, but numbers are not considered. During count day, observers track the effort spent counting birds by measuring party hours: the amount of time a group of observers spends together counting different birds. Over the years, different strategies have been employed on the Albuquerque CBC to split the entire circle into sectors of varying shapes and sizes to help ensure adequate coverage of the area and to divide effort into roughly equivalent sections; however, no information is available on these subdivisions from previous counts so the data used in this analysis consists of the combined counts for all sectors included in each count.

Data from the Albuquerque CBC through 2015 were downloaded from the central CBC database (National Audubon Society 2010). Data for 2016 through 2019 were obtained from the files of the author, who is presently the compiler of the Albuquerque CBC. To determine temporal trends, the number of birds per party hour for a species was computed by dividing total birds counted for a year of that species by total party hours reported for that year and then the birds per party hour was used in a linear regression against year. Potential competition between selected pairs of Columbids was explored with the Pearson product-moment correlation between birds per party hour of each set of species. All statistical analyses were performed with the R statistical package, version 4.0.3 (R Core Team 2020).

RESULTS

The Albuquerque CBC has changed over the years as the population of the urban area and state have grown, bird-watching has become more popular, and involvement in the CBC increased. Participation and counting effort on the Albuquerque CBC are shown in Figure 1, ranging from a minimum of 6 participants in 1969 to 86 in 2013. The long-term average number of participants was 34.4, but recent counts (last 20 years) have averaged 55.6 participants. Similarly, counting effort (as measured by number of party hours) has steadily increased (Figure 1), ranging from a minimum of 21.8 in 1978 to 173.3 in 2014. The long-term average number of party hours was 76.8 and recent counts (last 20 years) have averaged 122.9 party hours. To account for this variation in effort, the variable analyzed for any species in this report is the total number of individuals counted during a count divided by the number of party hours during the same count. While number of participants and party hours are highly correlated, party hours provide a more realistic metric of effort per count (since many birders count in groups of variable sizes) and is the variable typically used to account for variation in effort when analyzing CBC data (e.g., Bock and Root 1981, Sauer et al. 2004). A cumulative total of six species of Columbidae have been recorded on the Albuquerque CBC from 1961 to 2019. Each species is discussed separately below.

Rock Pigeon (*Columba livia*).—This species is considered introduced in North America (Lowther and Johnston 2020) and is now abundantly found in various human-associated habitats. As a result of methodological changes concerning counting, Rock Pigeons were only counted starting in 1973; therefore, though undoubtedly present in

the Albuquerque CBC area long prior to that time, I only include data from 1974 onward in this analysis, a total of 46 years.

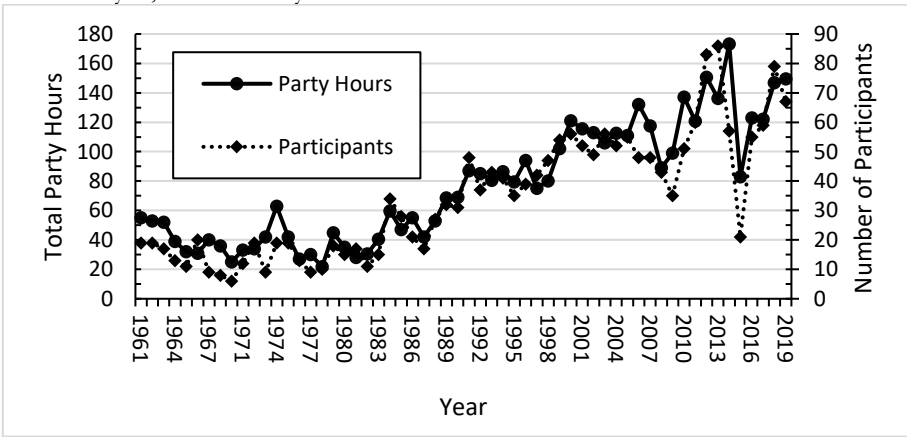

Figure 1. Total number of party hours (left axis) and number of participants (right axis) recorded by year from 1961 to 2019 on the Albuquerque Christmas Bird Count.

Rock Pigeon was reported on the first year it was eligible to be counted and has been in every year since (Figure 2). The average number of individuals counted over 46 years was 1205.7 with a maximum of 3970 in 2012. The number of Rock Pigeons per party hour steadily and significantly increased over the 46-year period at a rate of about 0.5 Rock Pigeons per party hour per year (Figure 2; $P < 0.001$, $r^2 = 0.76$). Although Rock Pigeon has always been the most frequently encountered Columbid on the Albuquerque CBC, the proportion of Rock Pigeon of all Columbidae counted has declined over time as other Columbid species have become more common, particularly from the 2000's to the present. The 46-year average was 82.2% Rock Pigeon of all Columbids counted, with an average of 94.8% between 1974–1990 and 70.1% between 2000–2019.

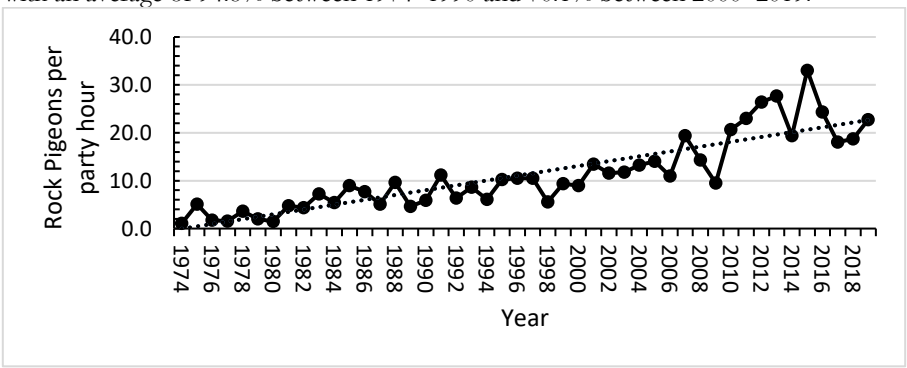

Figure 2. Number of Rock Pigeons counted per party hour from 1974 to 2019 on the Albuquerque Christmas Bird Count. Dotted line indicates best fit linear trend during this time period.

Eurasian Collared-Dove.—Eurasian Collared-Dove is another introduction to the North American avifauna, having been released in the Bahamas in the mid-1970's and spread across the continent since then (Romagosa 2020). The species was first reported in New Mexico in 1995 (S. Williams, pers. comm.) and first counted (a single bird) on the Albuquerque CBC in 1999. Due to this species' occurrence pattern, analyses were conducted on count data from 1999 to 2019, a period of 21 years.

Eurasian Collared-Dove has been counted every year since 1999 in generally increasing numbers with a rapid increase in numbers between 2009 and 2010, 11 years after being first found, a peak in 2015, followed by recent stabilization (Figure 3). The average number of individuals counted over the 21 years was 55.5 with a maximum of 369 counted in 2015. The linear regression of Eurasian Collared-Doves per party hour during this time period (Figure 3) is highly significant with an increase of about 0.13 doves per party hour per year ($P = 0.000159$, $r^2 = 0.54$).

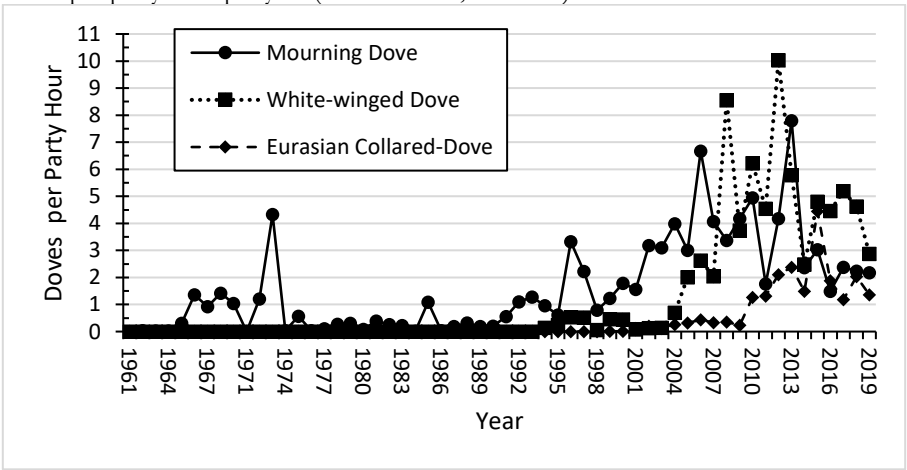

Figure 3. Number of Mourning Doves, White-winged Doves, and Eurasian Collared Doves counted per party hour from 1962 to 2019 on the Albuquerque Christmas Bird Count.

Inca Dove (*Columbina inca*).—Inca Dove is a native species whose stronghold in New Mexico was in the southwest part of the state; it has expanded its distribution both in the state and in the United States in the late 20th century (Phillips 1968, Hubbard 1978, Mueller 2004). Inca Dove has only been found on the Albuquerque CBC on nine years (15.5% of the total of 58, including on count week in one year), the first time in 1998 and the last time in 2007 (Figure 4). The maximum number ever counted was 6 birds in 2005.

Ruddy Ground Dove (*Columbina talpacoti*).—Ruddy Ground-Dove is considered a very rare species in New Mexico and requires detailed documentation when found (NMOS 2020). This species has only been reported on the Albuquerque CBC once,

during count week in 2002. This record was verified and was part of an invasion that fall and early winter (*North Am. Birds* 57(2):236, *NMOS Field Notes* 42(1):7).

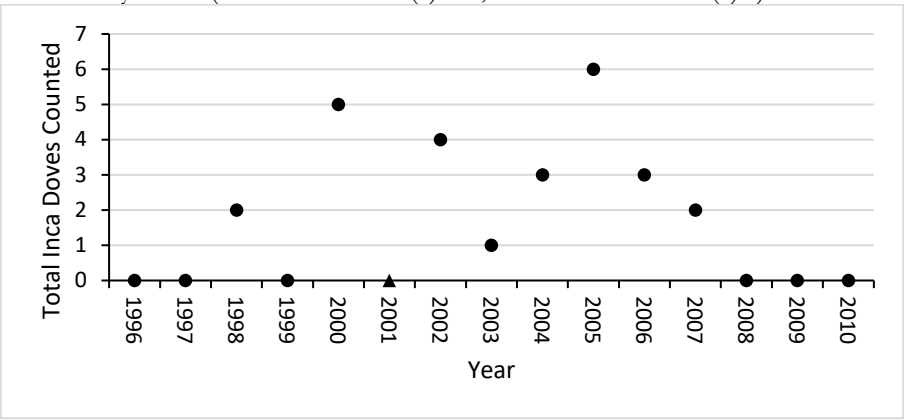

Figure 4. Number of Inca Doves counted between 1996 and 2010 on the Albuquerque Christmas Bird Count. No Inca Doves were found before 1998 or after 2007; the triangle indicates that it was found on count week.

White-winged Dove.—White-winged Dove is a native species to New Mexico, formerly considered resident or a summering species in southern New Mexico (Hubbard 1978). However, it has experienced a notable northward range expansion since the 1980's, perhaps associated with increased human density and human-associated agriculture and ornamental trees in the southwest (Schwertner et al. 2002). This dove was first found on the Albuquerque CBC in 1994 and has been encountered every year since for a total of 26 years; therefore, analyses were conducted on count data from 1994 to 2019, a period of 26 years.

White-winged Dove counts have increased over this time period, starting with an initial relatively stable period from 1994 to 2004, then dramatic increases with fluctuations until 2013, followed by an apparent stabilization between 2014 and 2019 (Figure 3). The average count over the 26 years was 350.3 individuals (2.8 doves per party hour) with a maximum of 1,509 counted in 2012. The linear regression of White-winged Doves per party hour during this time period was highly significant with an increase of about 0.26 doves per party hour per year ($P < 0.001$, $r^2 = 0.49$).

Mourning Dove (*Zenaida macroura*).—One of the most abundant terrestrial native bird species in North America (Otis et al. 2008), the Mourning Dove has been the most regularly encountered Columbid on the Albuquerque CBC, found in almost every year since 1961, with the exception of 2 years (1961, when it was found on count week, and 1971, when none were counted). The average count over the 58 years between 1962 and 2019 was 174.2 birds (1.65 birds per party hour) with a maximum of 1,061 birds counted (7.79 birds per party hour) in 2013.

Mourning Dove, like most of the other species discussed, generally increased in abundance over time (Figure 3) with lower numbers until the mid-1990's, at which point counts noticeably increased until 2013 with an apparent reduction in very recent years. The average for the most recent 20 years was 415.3 birds (3.36 birds per party hour), considerably higher than the long-term average of 174.2. The linear regression of Mourning Doves per party hour during this time period was highly significant with an increase of about 0.067 doves per party hour per year ($P < 0.001$, $r^2 = 0.39$).

Interspecific Interactions.—It has been suggested that the effects of newly introduced or expanding species on existing species could or should be negative; this is particularly true for the Eurasian Collared-Dove (e.g., *Romagosa* and McEneaney 1999). The Albuquerque CBC provides the opportunity to examine this topic with several species of Columbids that have changed their population status over time, the expectation being that as a new species increases over time, then the existing species would decrease correspondingly if there were competitive interactions.

When numbers of birds counted per party hour were compared pairwise across three species of Columbids there was little evidence of a negative effect of the newer species on the previously existing species. Rather, the effects were all positive, two of the three significantly so, for all three possible species interactions during years in which they were counted: White-winged Dove on Mourning Dove ($r = 0.423$, $P = 0.031$, N = 26 years), Eurasian Collared-Dove on Mourning Dove ($r = 0.119$, $P = 0.606$, N = 21 years), and Eurasian Collared-Dove on White-winged Dove (r = 0.543, $P = 0.011$, N = 21 years).

DISCUSSION

Albuquerque CBC data clearly document substantial changes in species composition and numbers of Columbidae in the local area over the past several decades. Rock Pigeon, an introduced and ubiquitous bird species on the entire continent, has steadily increased in abundance since it was first counted in the mid-1970's (Figure 2) and continues to the present day to be the most abundant Columbid on the Albuquerque CBC. Mourning Dove, a familiar native species found throughout the area, was the most frequently encountered Columbid on the Albuquerque CBC, counted on 98% of count years. It, too, increased in abundance over the past three decades (Figure 3), albeit in a non-linear fashion, with a noticeable increase in birds counted since the mid-1990's. The two most-recent additions to the local Columbid fauna, White-winged Dove in 1994 and Eurasian Collared-Dove in 1999, also showed noticeable increases in abundance during their time since appearance (Figure 3). Interestingly, both species showed a lag time of about 10 years since first appearance before abundance began to increase markedly. Inca Dove was only counted or found on count week in nine years between and including 1997 and 2008 (Figure 4). Apparently, this species' appearance in the area in the late 1990's did not result in long-term, sustainable population increases as in the other species. A final Columbid, Ruddy Ground-Dove, is extremely rare in the state and was recorded during only one Albuquerque CBC.

Despite these noticeable changes in abundance of various Columbids over time, there was no evidence of any competitive (negative) effect of a newly occurring species on

those previously found on the count. In fact, abundances of White-winged Dove (the new species) and Mourning Dove (the previously occurring species) were significantly positively correlated with each over as were abundances of Eurasian Collared-Dove (the new species) and White-winged Dove (the previously occurring species). This suggests that rather than any displacement or competition between the new and previously occurring species, there was an increase in Columbidae in general in the region. This was supported by the regression of total number of Columbidae counted (without Rock Pigeon) per party hour against year, which was highly significant with an increase of about 0.194 doves per party hour per year ($P < 0.001$, $r^2 = 0.56$). Although it makes intuitive sense that taxonomically and ecologically similar species such as the Mourning and White-winged Dove and Eurasian Collared-Dove should compete with each other as their respective abundances change through time, this is primarily an anecdotally reported effect (Romagosa and McEneaney 1999, Romagosa and Labisky 2000, Romagosa 2020) and is not supported by data from the Albuquerque CBC nor by other studies (Poling and Hayslette 2006).

It seems reasonable to hypothesize that these consistent increases in the abundance of Columbidae in early winter the Albuquerque area were due to a combination of more and better quality Columbid habitat as the urban/suburban area has grown, more bird feeding stations, and continuing increases in temperature (Gonzalez et al. 2018, Frankson et al. 2019). All these hypotheses represent areas for future research and analysis. Interestingly, all three of the dove species regularly counted showed a decline and relative stabilization of numbers starting in the mid-2010's after a period of continuous increase (Figure 3). Since the factors presumably driving Columbid increases have undoubtedly continued in recent years, other explanations for this apparent stabilization at lower numbers could include predation by the growing urban population of Cooper's Hawks (*Accipiter cooperii*), which is known to feed substantially on doves in the Albuquerque area (Millsap 2018, Rosenfield 2020) and shows steadily increasing populations on the Albuquerque CBC (Mehlman unpubl. analysis), some undetected disease, or a functional limit on the population size. Scheidt and Hurlbert (2014) found a decline after rapid growth in older populations of Eurasian Collared-Dove at sites in the U.S. and suggested it may be an indication of local carrying capacity being reached. All these hypotheses, as well as alternative explanations, require further investigation; the Columbid species discussed show low susceptibility to viral and other diseases (LaDeau et al. 2007, Mueller 2004, Otis et al. 2008, Romagosa 2020, Schwertner et al. 2002). The case of Columbidae on the Albuquerque CBC provides a very interesting study of changing bird populations over decadal time scales and at local spatial extents. The CBC also demonstrates the value of citizen science projects for documenting trends as well as posing numerous interesting questions for those studying changing environmental variables and their interactions in central New Mexico.

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LITERATURE CITED

Bock, C.E., and T.L. Root. 1981. The Christmas Bird Count and avian ecology. Studies in Avian Biology 6:17–23.

Dunn, E.H., C.M. Francis, P.J. Blancher, S.R. Drennan, M.A. Howe, D. Lepage, C.S. Robbins, K.V. Rosenberg, J.R. Sauer, and K.G. Smith. 2005. Enhancing the scientific value of the Christmas Bird Count. The Auk 122(1):338–346.

Frankson, R., K. Kunkel, L. Stevens, and D. Easterling. 2019. New Mexico State Climate Summary. NOAA Technical Report NESDIS 149-NM, May 2019 Revision. statesummaries.ncis.org/chapter.nm

Gonzalez, P., G.M. Garfin, D.D. Breshears, K.M. Brooks, H.E. Brown, E.H. Elias, A. Gunasekara, N. Huntly, J.K. Maldonado, N.J. Mantua, H.G. Margolis, S. McAfee, B.R. Middleton, and B.H. Udall. 2018. Southwest, in Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II (D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart, eds.). U.S. Global Change Research Program, Washington, DC, USA. doi: 10.7930/NCA4.2018.CH25

Hubbard, J.P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publication No. 6.

LaDeau, S.L., A.M. Kilpatrick, and P.P. Marra. 2007. West Nile virus emergence and large-scale declines of North American bird populations. Nature 447:710–713.

Lowther, P.E., and R.F. Johnston. 2020. Rock Pigeon (*Columba livia*), version 1.0. In Birds of the World (S.M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.rocpig.01

Millsap, B.A. 2018. Demography and metapopulation dynamics of an urban Cooper's Hawk subpopulation. The Condor 120(1):63–80.

Mueller, A.J. 2004. Inca Dove (*Columbina inca*), version 1.0. In Birds of the World (A.F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.incdov.01

National Audubon Society. 2010. The Christmas Bird Count Historical Results. Online: www.christmasbirdcount.org.

New Mexico Ornithological Society (NMOS). 2020. Review List, July 2020. Online: www.nmbirds.org/nmbrc/. Accessed on October 5, 2020.

New Mexico Ornithological Society (NMOS). 2020. NMOS Field Notes Database 1962–2009. Natural Heritage New Mexico (database designer/server), Albuquerque, New Mexico. Online: nhnm.unm.edu/partners/NMOS. Accessed on May 26, 2020.

Otis, D.L., J.H. Schulz, D. Miller, R.E. Mirarchi, and T.S. Baskett. 2008. Mourning Dove (*Zenaida macroura*), version 1.0. In Birds of the World (A.F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.moudov.01

Poling, T.D., and S.E. Hayslette. 2006. Dietary overlap and foraging competition between Mourning Doves and Eurasian Collared-Doves. Journal of Wildlife Management 70(4):998–1004.

Phillips, A.R. 1968. The instability of the distribution of land birds in the southwest, in Collected Papers in Honor of Lyndon Lane Hargrave (A.H. Schroeder, ed.), pp. 129–162. Papers of the Archaeological Society of New Mexico 1.

Romagosa, C.M. 2020. Eurasian Collared-Dove (*Streptopelia decaocto*), version 1.0. In Birds of the World (S.M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.eucdov.01

Romagosa, C.M., and R.F. Labisky. 2000. Establishment and dispersal of the Eurasian Collared-Dove in Florida. Journal of Field Ornithology 71(1):159–166.

Romagosa, C.M., and T. McEneaney. 1999. Eurasian Collared-Dove in North America and the Caribbean. North American Birds 53:348–353.

R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. www.R-project.org.

Rosenfield, R.N., K.K. Madden, J. Bielefeldt, and O.E. Curtis. 2020. Cooper's Hawk (*Accipiter cooperii*), version 1.0. In Birds of the World (P.G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.coohaw.01

Sauer, J.R., D.K. Niven, and W.A. Link. 2004. Statistical analyses make the Christmas Bird Count relevant for conservation. American Birds 58:21–25.

Scheidt, S.N., and A.H. Hurlbert. 2014. Range expansion and population dynamics of an invasive species: The Eurasian Collared-Dove (*Streptopelia decaocto*). PLoS ONE 9(10):e111510. doi:10.1371/journal.pone.0111510

Schwertner, T.W., H.A. Mathewson, J.A. Roberson, and G.L. Waggerman. 2002. White-winged Dove (*Zenaida asiatica*), version 1.0. In Birds of the World (A.F. Poole and F.B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. doi.org/10.2173/bow.whwdov.01

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