

**BREEDING BEHAVIOR OF A REINTRODUCED PAIR OF ANDEAN CONDOR (*VULTUR GRYPHUS*) IN THE CENTRAL ANDES OF COLOMBIA**

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Abstract · Between 1989–2013, 69 Andean Condors (*Vultur gryphus*) were reintroduced in eight sites in the Andes of Colombia. Due to the lack of monitoring programs, little is known about the ecology and biology of these reintroduced populations. We present the first observations on a reintroduced breeding pair. For 36 months, we examined the breeding behavior of a pair of condors in a nest cave in the central Andes of Colombia. In June 2013, we observed a chick of about 6–7 months of age in the nest cave. The most remarkable outcomes of these observations are (1) that females spend more time guarding the chick whereas (2) males focus on guarding the nest cave. While the chick was in the nest cave (80 h of observations), the female was present in the vicinity of the nest cave and attended the chick for a longer time period than the male. However, in the absence of a chick or eggs (880 h of observations), the male was observed more often in the vicinity of the nest cave than the female. Nevertheless, we found no significant differences in vigilance patterns between the sexes. Intraspecific interactions of the Andean Condor with other raptors in the area were recorded during the observation period of this study. We make some predictions on the timing of reproduction of condors based on this reintroduced pair in Colombia and compare them with those reported elsewhere. Tracking released populations of condors is essential to ensure the positive impact of reintroduction efforts.

Resumen · Comportamiento reproductivo de una pareja reintroducida de Cóndor Andino (*Vultur gryphus*) en la cordillera Central de Colombia

Entre 1989–2013, 69 individuos de Cóndor Andino (*Vultur gryphus*) fueron liberados en ocho núcleos de repoblación en la región andina de Colombia. Debido a la falta de seguimiento de estas liberaciones, se conoce poco sobre la biología y ecología de la especie en esos núcleos de repoblación. Presentamos la primera información de seguimiento del comportamiento reproductivo de una pareja en los núcleos de repoblación. Por un periodo de 36 meses examinamos el comportamiento reproductivo de esa pareja en un nido encontrado en la cordillera Central de Colombia. En junio de 2013 registramos la presencia de un polluelo de aproximadamente seis a siete meses de edad en el nido. Mientras el polluelo estuvo en el nido (80 h de observación), la hembra permaneció dentro de la vecindad e interactuó por más tiempo con el polluelo en comparación con el macho. En ausencia de polluelo o postura (880 h de observación), el macho permaneció dentro del territorio por un mayor número de horas en comparación con la hembra, aunque estas diferencias no fueron estadísticamente significativas. Registramos interacciones interespecíficas directas entre el Cóndor Andino y rapaces que ingresaron a su área de anidación. El seguimiento de las poblaciones de cóndor liberadas es clave para garantizar el impacto positivo de los esfuerzos de reintroducción como herramienta para la conservación.

Key words: Conservation · Intraspecific interactions · Nest cave · *Vultur gryphus*

INTRODUCTION

The Andean Condor (*Vultur gryphus*) is distributed along the Andes from Venezuela to the south in Argentina and Chile (Lambertucci 2007). In Colombia, their populations are reduced in number and restricted to a few localities, the Eastern and Central Andes, the Colombian Massif, Serranía de Perijá and the Sierra Nevada de

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Santa Marta (Renjifo et al. 2016). Due to threats such as loss of habitat, hunting pressure, carrion poisoning, collision with power lines, and competition with introduced species, such as dogs (*Canis lupus familiaris*), it is classified as Critically Endangered for the country (Renjifo et al. 2016) and on a global scale, considered Near Threatened (Birdlife International 2018).

Between 1989 and 2013, 69 Andean Condor specimens (36 males and 33 females) were released in eight repopulation areas in Colombia (Lieberman et al. 1993, Renjifo et al. 2016, pers. obs.). There has been little follow up to these introductions. Of these introductions, 32 individuals have been recorded in the last 10 years, with 13 individuals confirmed dead and 24 of unknown status (pers. obs.). Due to the lack of monitoring following these releases, we know little on the biology and ecology of these birds, and the number of individuals that have reproduced is unknown.

Knowledge about the breeding biology of the Andean Condor in the wild is key to the development of reintroduction processes. However, this information comes from specific observations of a few, geographically distant nests caves in Argentina, Chile, and Ecuador (Pavez & Tala 1995, Köster 1997, Lambertucci & Mastrantuoni 2008). In Colombia, the few known records of Andean Condor nests caves correspond to those made by McGahan (1972) in the Pasto River canyon, Nariño department, and to the recent discovery made by Sáenz-Jiménez et al. (2016) on a cliff in the paramo del Almorzadero, department of Santander where a pair incubated an egg over two months, which did not hatch.

The purpose of this study is to present observations on the breeding behavior of a reintroduced pair in Villamaría, Central Andes of Colombia. We describe (1) the fate of a single chick produced by this pair, (2) document the behavior of each adult in the nest cave in the presence and absence of the chick, and (3) provide a record of their interactions with other species of raptors.

METHODS

Study area. The study was done in the sector Cargaperros (04°56'N, 75°29'W; 2347 m a.s.l.), located in the second order stream of the Claro river that forms part of the Chinchiná river basin, in the municipality of Villamaría, department of Caldas, Colombia (Figure 1). An Andean Condor nest cave was found at 295 m above the ground in a fissure located in a rocky escarpment facing south of the Cargaperros plateau, with herbaceous vegetation surrounding the entrance of the nest cave formed by ferns of the family Polypodiaceae. The area is classified as a “bosque muy húmedo montano”, bmh-M (Holdridge 1967), and corresponds to a mosaic of relics of secondary forest, pine plantations (*Pinus patula*), and human settlements immersed in a matrix of open areas for

livestock. The area where the nest cave is located is not within any conservation figure.

Behavioral observations. Between April–July and October–December 2013, and February–April, June, and October 2014, we visited the site 12 times (one visit/month), each visit lasting two days. During December 2015–November 2017, 24 visits were held, each lasting three days. We did systematic observations between 08:00 and 18:00 h, using binoculars (10×42) and a telescope (20–60×65), from an elevated point located at 295 m linear distance to the nest cave. A total of 960 h of observation were obtained. To describe the behavior of the pair, we defined the geographical neighborhood of the nest as an approximate area of 1 km² around the nest cave (Lambertucci & Mastrantuoni 2008). In this area, we recorded the time that each adult remained within the neighborhood, the number of hours that each adult interacted with the chick in the nest cave, and the number of agonistic encounters between each adult and the raptors that entered the neighborhood. We performed a proportion z tests to determine significant differences in the number of hours each adult remained within the neighborhood and the nest cave.

RESULTS

Observations of the chick in the nest cave. We collected observations of a single chick at the nest cave for almost one month. On 25 June 2013, we identified the presence of a chick of about 6 to 7 months of age in the nest cave. On 20 July the chick fell prematurely from a perch near the nest cave and crashed into vegetation. Even though the chick was rescued, it died shortly after.

We observed the nest cave while the chick was present for 80 h. During that time, the female remained within the neighborhood for longer (47.9 h, 59.8%) than the male (38.7 h, 48.3%). This difference in proportions was not statistically significant ($z = 1.79$, $P = 0.07$), and on several occasions, both parents were present simultaneously. Because there was no access to the interior of the nest cave, the time each adult remained inside the nest cave was considered as the number of hours that they interacted with the chick. Under this assumption, the time the chick interacted with each parent was not statistically different ($z = 0.77$, $P = 0.43$), although the female interacted more with the chick (10.4 h, 21.7%), compared to the male (5.5 h, 14.2%). The two adults were never observed together inside the nest cave. On one occasion, the male entered the nest cave with a full crop coming out 9 seconds later with an apparently empty crop. This behavior that was not recorded for the female.

Relationships with other raptors. While the chick stayed in the nest cave, on two occasions the male displaced from the neighborhood a Black Vulture

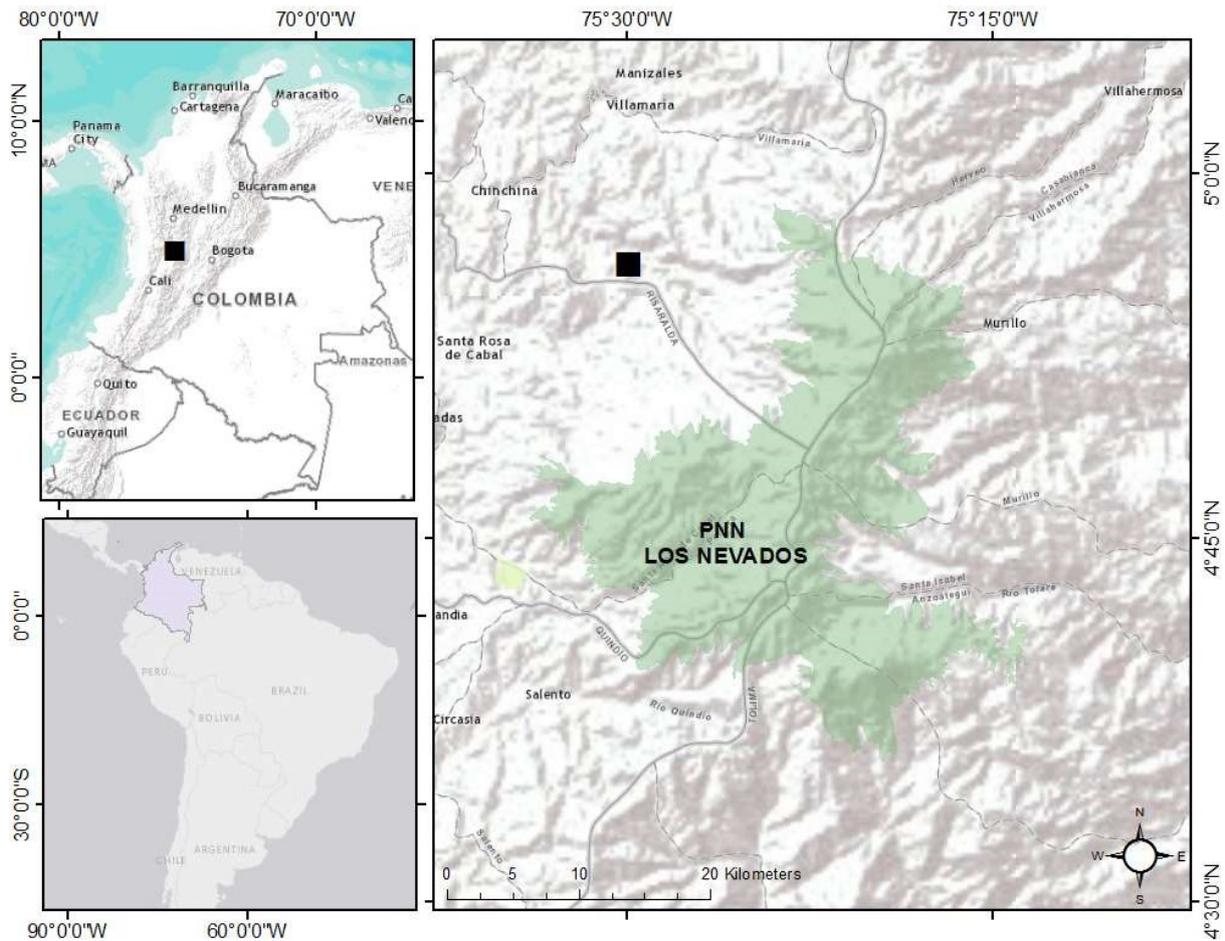


Figure 1. Location of the Andean Condor (*Vultur gryphus*) nest cave in Villamaría, department of Caldas, Colombia.

(*Coragyps atratus*), while the female was displaced by a White-tailed Hawk (*Geranoaetus albicaudatus*). During the time with no chick in the nest cave, the male displaced on four occasions two individuals of *C. atratus*, while the female displaced individuals of the same species on six occasions, and on two occasions the female displaced two individuals of the Northern Crested Caracara (*Caracara cheriway*). On two occasions, we recorded *C. atratus* being aggressive towards the male and on one occasion towards the female. *G. albicaudatus* displaced from the neighborhood to the male on one occasion, and on three occasions an individual of *C. cheriway* attacked the male.

Guarding of the nest cave. Due to the death of the chick, the pair again used the nest cave and other perches in the rocky escarpment, but no breeding behavior was observed. For 880 hours we conducted observations with no evidence of egg laying (October–December 2013; February–April, June, and October 2014; December 2015–November 2017). During that time, the male remained within the neighborhood a greater number of hours, 234.1 h (26.6%), compared to the female, 219.2 h (24.9%), even though these values were not significantly different ($z = 1.16, P = 0.24$).

DISCUSSION

Approximate timing of breeding events. Taking into account the approximate age of the chick (between 6 and 7 months), we assume, according to Lambertucci & Mastrantuoni (2008), that courtship display and copulation behaviors occurred between July and September 2012, egg incubation between October and December of the same year, and hatching between the end of November of 2012 and the beginning of January of 2013.

Egg-laying occurs between October and December in Argentina and Chile (Pavez & Tala 1995, Lambertucci & Mastrantuoni 2008). According to Lambertucci & Mastrantuoni (2008), the incubation period lasts two months; the chick stays in the nest cave for six months after hatching and leaves the nest cave after 15 months. In Peru (Wallace & Temple 1988) and Bolivia (Ríos-Uzeda & Wallace 2007), egg-laying and incubation periods occur between February and June. In Colombia, it is presumed that egg-laying occurs between April and December (Ferguson-Lees & Christie 2001), which agrees with a possible laying of the chick's egg observed by October. However, in the nest cave found by Sáenz-Jiménez et al. (2016), in the eastern Andes of Colombia, the

posture happened in February by a pair of wild-born (i.e., not reintroduced) individuals. The different seasons of egg-laying between these two localities may be due to differences in breeding behaviors between reintroduced individuals and native condors, climatic differences, and/or availability of food between the two localities, or simply the lack of knowledge of the breeding aspects of the species in Colombia.

Offspring care. Although in this study there were no significant differences in the interaction time of each adult with the chick, in Argentina (Lambertucci & Mastrantuoni 2008) and Ecuador (Köster 1997), it was the male that interacted most with the chick in the nest cave. Conversely, in the nest cave found at paramo del Almorzadero, Colombia, the female attended the chick for a significantly longer time than the male (Sáenz-Jiménez et al. 2016).

Territory defense. The observations made show the direct interspecific interactions between the Andean Condor and other species entering their nesting area in the Andes of Colombia. *Coragyps atratus* was considered to be a strong competitor for the condor in environments where it is very abundant, especially for females and juveniles of the condor (Carrete et al. 2010, Lambertucci et al. 2012). In Chile, aggression from the Black-chested Buzzard-Eagle (*Geranoaetus melanoleucus*) on the Andean Condor was also observed (Kusch 2006). In southern Colombia, near the Chiles volcano, in the department of Nariño, there were competitive interactions for food (carrión) between reintroduced condors and the Carunculated Caracara (*Phalcoboenus carunculatus*) (Bastidas pers. obs.). Likewise, in the Parque Nacional Natural Los Nevados, central Andes of Colombia, aggression from the Carunculated Caracara on reintroduced condors was observed near the breeding sites of *P. carunculatus* (pers. obs.).

Implications for conservation. This study contributes to the limited knowledge of the breeding ecology of the condor, especially of reintroduced populations, since of the 69 Andean Condors reintroduced in Colombia; the studied pair is the only one with evidence of reproduction. In the absence of population monitoring programs, it is difficult to determine the role of condor reintroduction in the maintenance of populations in the country. In a sense, the success of species re-establishment programs at sites where their populations were extirpated, would be determined by the number of individuals that reproduce, as this is one of the criteria determined in the evaluation of species extinction risk assessments according to IUCN (2001). As part of the reintroduction and captive breeding programs, is important to monitor the released individuals using satellite telemetry, assess factors that limit the viability of natural and reintroduced populations, and understand aspects of the ecology and genetics of repopulation areas to maximize those efforts of conservation. Likewise, in the

planning of important areas for the maintenance of Andean Condor's populations, it is key to evaluate potential new areas of protection that offer direct benefits to these birds, such as nesting and breeding sites in rural landscapes of Colombia.

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REFERENCES

- BirdLife International 2018. *Vultur gryphus*. In: IUCN Red list of threatened species. Version 2012.1. Available at <http://www.iucnredlist.org> [Accessed 17 July 2018].
- Carrete, M, SA Lambertucci, K Speziale, O Ceballos, A Travaini, M Delibes, F Hiraldo & JA Donázar (2010) Winners and losers in human-made habitats: interspecific competition outcomes in two Neotropical vultures. *Animal Conservation* 13: 390–398.
- Ferguson-Lees, JD & A Christie (2001) *Raptors of the World*. Christopher Helm, London, UK.
- Holdridge, LR (1967) *Life zone ecology*. Tropical Science Center, San José, Costa Rica.
- IUCN (2001) *Red List Categories and Criteria*. Versión 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, UK.
- Köster, F (1997) *Los Cóndores de Papallacta*. Instituto Ecuatoriano Forestal y de Áreas Naturales y Vida Silvestre (INEFAN), Empresa Municipal de Agua Potable y Alcantarillado de Quito (EMAAP-Q), Fundación Rumicocha y Fundación Ornitológica del Ecuador (CECIA). Impresiones Signo, Quito, Ecuador.
- Kusch, A (2006) Posaderos de Cóndor Andino *Vultur gryphus* en el extremo sur de Chile: antecedentes para la conservación de la especie. *Cotinga* 25: 65–68.
- Lambertucci, SA (2007) Biología y conservación del Cóndor Andino en Argentina. *El Hornero* 22: 149–158.
- Lambertucci, SA & OA Mastrantuoni (2008) Breeding behavior of a pair of free-living Andean Condors. *Journal of Field Ornithology* 79: 147–151.
- Lambertucci, SA, M Carrete, JA Donázar & F Hiraldo (2012) Large-scale age-dependent skewed sex ratio in a sexually dimorphic avian scavenger. *PLoS One* 7: 1–6.
- Lieberman, A, JV Rodríguez, JM Paez, & J Wiley (1993) The reintroduction of the Andean Condor into Colombia, South America: 1989-1991. *Oryx* 27: 83–90.
- Renjifo, LM, ÁM Amaya-Villarreal, J Burbano-Girón & J Velásquez-Tibatá (2016) *Libro rojo de aves de Colombia. Vol II: Ecosistemas abiertos, secos, insulares, acuáticos continentales, marinos, tierras altas del Darién y Sierra Nevada de Santa Marta y bosques húmedos del centro, norte y oriente del país*. Pontificia Universidad Javeriana e Insti-

- tuto Alexander von Humboldt, Bogotá, Colombia.
- Pavez, EF & C Tala (1995) *Río Blanco, la herencia de los glaciares*. Editorial Antártica, Santiago, Chile.
- Ríos-Uzeda, B & RB Wallace (2007) Estimating the size of the Andean Condor population in the Apolobamba Mountains of Bolivia. *Journal of Field Ornithology* 78: 170–175.
- McGahan, J (1972) Behavior and ecology of the Andean Condor. Ph.D. diss., Univ. of Wisconsin, Wisconsin, USA.
- Sáenz-Jiménez, F, A Parrado-Vargas, J Pérez-Torres, JK Shepard & F Ciri (2016) Andean Condor (*Vultur gryphus*) nesting in northeastern Colombia and differences in laying dates along the Andes. *Ornitología Neotropical* 27: 67–71.
- Wallace, MP & SA Temple (1988) Impacts of the 1982-1983 El Niño on population dynamics of Andean Condors in Peru. *Biotropica* 20: 144–150.

