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LETTERS

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NEST RECORDS OF TWO LARGE EAGLES IN COLOMBIA AND ECUADOR

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Eagles are the largest representatives among raptors and many species are endangered or threatened, primarily due to their habitat requirements and potential conflicts with human activities (Newton 1979, Meyburg 1986). These large birds of prey typically breed at low densities and require large tracts of relatively undisturbed habitat (Newton 1979). Fragmentation and reduction of habitat and human persecution to prevent livestock losses contribute to the decline of their populations (Córdoba-Córdoba et al. 2008, Acevedo-Charry et al. 2015, Zuluaga and Echeverry-Galvis 2016, Muñiz-López 2017).

The Black-and-chestnut Eagle (*Spizaetus isidori*) is one of the least known Neotropical birds of prey (Valdez and Osborn 2004, Zuluaga 2012). With an estimated population of fewer than 1000 individuals and a declining population trend, the species is listed as Endangered (Renjifo et al. 2014, BirdLife International 2017a). This eagle breeds in Andean tropical and subtropical montane rainforests usually from 1800–2500 masl, across a broad latitudinal but narrow longitudinal range from northern Venezuela and Colombia, through Ecuador, Peru and Bolivia to northwestern Argentina (Ferguson-Lees and Christie 2001, Aráoz et al. 2017). Between 1915 and 2000, only seven nest records were published for this species (Lehmann 1959, 1961, Strewe 1999, Zuluaga 2012, Table 1). However, since 2010, approximately 10 new occupied nests have been located in Colombia, Ecuador, Peru, and Argentina (Table 1).

The Harpy Eagle (*Harpia harpyja*), one of the largest eagles in the world (Brown and Amadon 1968), inhabits the canopy of lowland (usually below 900 masl) Neotropical rainforest and is of high conservation concern across its entire range. This eagle is classified as Near Threatened worldwide due to an apparently decreasing population trend that is mainly explained by habitat loss and human persecution (BirdLife International 2017b). Historically, the species ranged from southern Mexico to northeastern Argentina and Bolivia (Ferguson-Lees and Christie 2001, Bierregaard et al. 2017). Anthropogenic pressure through persecution and deforestation are the main causes for its population decline and has led to a reduction in its range (Vargas-González et al. 2006, BirdLife International 2017b). The species is classified as locally and regionally

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Table 1. Known nest records of the Black-and-chestnut Eagle in South America. Study year indicates the period of time (years) in which nests were found and/or monitored. Region indicates the state, province or specified zone in which nests were located.

COUNTRY	REGION	STUDY YEAR	NO. OF NESTS	SOURCE
Argentina	Jujuy	2014–2018	1	Araóz et al. (2017)
Bolivia	Incachaca	1915	1	Lehmann (1959)
Colombia	Cauca	1936	1	Lehmann (1959)
	Huila	1950–1959	4	Lehmann (1959)
	Huila	2016–2018	2	J. Restrepo-Cardona pers. comm.
	Nariño	1997	1	Strewe (1999)
	Boyacá	2010	1	Corporación Autónoma Regional de Chivor (2016)
	Cundinamarca	2014–2018	2	This study, Zuluaga and Echeverry-Galvis (2016), Zuluaga et al. (2018)
	Antioquia	2016–2018	3	J. Restrepo-Cardona pers.comm.
Ecuador	Loja	1997	1	R. Tapia pers. comm.
	Pichincha	2008	1	H. Vargas pers. comm.
	Imbabura	2014–2018	1	This study
	Tungurahua	2015–2018	1	J. Robayo pers. comm.
	Napo	2017–2018	2	H. Vargas et al. unpubl. data
	Morona Santiago	2017	1	S. Kohn pers. comm.
Perú	Junín	2017	1	T. Rivas-Fuenzalida pers. comm.

extirpated in several locations of Central America and at the southern limit of its distribution in South America (Rio Grande do Sul, Brazil; BirdLife International 2017b). Between 1959 and 2016, there were records of more than 100 Harpy Eagle nests in Central and South America (Table 2). However, there were no published records of Harpy Eagle nests on the Pacific slope west of the Andes in South America until the first nest was found in Ecuador (Muñiz-López 2005).

Here we describe two Black-and-chestnut Eagle nests in Colombia, one occupied nest (previously noted in Zuluaga and Echeverry-Galvis 2016) and one new nest, unoccupied, as well as a new, occupied nest of this eagle in Ecuador. We also describe a new, occupied nest for the Harpy Eagle in Colombia. We here define an occupied nest as a nest that contains eggs, young, or an incubating bird, or has a pair of birds on or near it, or has been recently repaired or decorated (Steenhof et al. 2017). The occupied Black-and-chestnut Eagle nest in Colombia was monitored from 2014–2016 (Zuluaga and Echeverry-Galvis 2016) and the unoccupied nest was monitored from 2016–2018; both nests were located in the Eastern Andes. The occupied nest of the Black-and-chestnut Eagle from the Western Andes of Ecuador was monitored from 2013–2018. The Harpy Eagle nest was the first nest recorded in Colombia and only the second nest of this species described from the west side of the Andes (the Pacific Slope) in South America. This nest was monitored from 2016–2018.

We measured several habitat characteristics within a 0.5-ha area surrounding the Black-and-chestnut Eagle nests in July 2014, January 2017 and February 2018, and the Harpy Eagle nest in November 2016. Within this area at each nest, we calculated tree density using the point-centered quarter method (Cottam and Curtis 1956) and included only trees with a dbh >20 cm. To determine slope at the nest site, we used the mean of five slope measurements taken with a clinometer at the base of the nest tree and at 25 m from the nest tree in each cardinal direction. We calculated percent canopy cover as the mean of five measurements taken with a spherical densiometer at the same five points used for the slope measurements. We also measured slope aspect (cardinal direction in which the slope was facing), and determined the elevation (masl) at each nest tree. We recorded the following characteristics of the nest tree itself: species, whether it was emergent or non-emergent, diameter at breast height (dbh, in m), total tree height (m), number of branches supporting the nest structure, and fork-angle of main supporting branches. We climbed all nest trees in Colombia and measured the dimensions of each nest following Simon and Pacheco (2005). In Ecuador, the nest tree could not be climbed for safety reasons; thus we estimated the nest dimensions.

The occupied Black-and-chestnut Eagle nest in Colombia (4°41.608′N, 73°31.237′W) was found on 14 March 2014 in the biological corridor "Farallones de Gachalá y Medina" in the municipality of Gachalá in the department of Cundinamarca, within the jurisdiction of the regional environmental authority, Corporación Autónoma Regional del Guavio (Zuluaga and Echeverry-Galvis 2016). When we found the nest, the nestling was approximately 6 wk old and was still covered in white downy feathers, with dark remiges from the wings starting to emerge. We estimated the

Table 2. Known nest records of the Harpy Eagle across Central and South America. Study year indicates the period of time (years) in which nests were found and/or monitored. Region indicates the state, province or specified zone in which nests were located.

COUNTRY	REGION	SLOPE	STUDY YEAR	NO. OF NESTS	SOURCE
Argentina	Misiones	Atlantic	1987–1988	3	Chebez et al. (1990)
	Misiones	Atlantic	1990–1992	1	De Lucca (1996)
	Misiones	Atlantic	2004–2005	1	Anfuso et al. (2008)
Brazil	Amazonas	Atlantic	2003–2005	5	Aguiar-Silva et al. (2014)
	Amazonas	Atlantic	2013–2015	1	Aguiar-Silva et al. (2017)
	Espírito Santo	Atlantic	2010	2	Aguiar-Silva et al. (2012)
	Pará	Atlantic	1997–1998	1	Galetti and Carvalho (2000)
	Pará	Atlantic	2011–2014	3	Sousa et al. (2015)
	Pará	Atlantic	2013–2015	6	Aguiar-Silva et al. (2015), Sanaiotti et al. (2015)
	Rondônia	Atlantic	2008–2013	5	Gusmão et al. (2016)
Belize	Maya Mountains	Atlantic	2010	1	Rotenberg et al. (2012)
Colombia	Chocó	Pacific	2016	1	This study
Ecuador	Esmeraldas	Pacific	2005	1	Muñiz-López (2005),
	Sucumbios	Atlantic	2002–2006	10	Muñiz-López et al. (2007)
Guyana	Kanuku Mointains	Atlantic	1959–1960	2	Fowler and Cope (1964)
Guyana	Kanuku Mointains	Atlantic	1974–1975	1	Rettig (1978)
Panama	Darién	Pacific	1989–2006	40	Álvarez-Cordero (1996), Vargas-González and Vargas (2011)
Peru	Tambopata	Atlantic	1996–2001	6	Piana (2007)
Suriname	Raleighvallen	Atlantic	2002–2004	1	Ford and Boinski (2007)
Venezuela	Imataca	Atlantic	1989–1996	29	Álvarez-Cordero (1996)

nestling's age based on photos from other monitored nests in Colombia (S. Zuluaga unpubl. data). On 3 May 2014, we observed that the nestling had fledged, at approximately 13 wk of age (Zuluaga et al. 2018). The nest tree was within a remnant forest patch approximately 309 ha in size that was almost completely surrounded by pastures used for grazing livestock. This forest patch was connected by three thin forested corridors (each approximately 75 m in width and 1000 m in length) to a larger patch of continuous dense natural forest approximately 52,287 ha in size. This nest was known by the local community for at least 50 yr (E. Linares pers. comm.). Situated within the buffer zone of the Chingaza National Natural Park and the Tolima Regional Protective Forest Reserve, the nest tree was a 48-m tall emergent fig (*Ficus* sp.) measuring 3.06 m dbh and was at 2038 masl. The nest was located 43 m high in the fig tree, in a fork of a secondary and two tertiary branches, where the angle of the main branch supporting the nest was 55°. The nest measured 1.1 m × 1.3 m in width and length and 0.6 m in depth. Within the 0.5-ha area surrounding the nest tree, tree density was 947 trees/ha and trees averaged 0.51 m ± 0.67 (SE) dbh. Canopy cover was 53%, slope inclination was 36° and the slope faced SSE.

The unoccupied Black-and-chestnut Eagle nest from Colombia was visited on 17 December 2016 in the municipality of Fomeque, in the department of Cundinamarca (4°29.097′N, 73°53.654′W). When visiting the nest, SZ observed an adult Black-and-chestnut Eagle flying above the nest. According to a local farmer (J. Rincon pers. comm.), the nest was last occupied by Black-and-chestnut Eagles in 2004, when a nestling from the nest was captured and kept in captivity by the farmer until it was confiscated by the Corporación Autónoma Regional del Guavio. Although not monitored since 2004, the nest has been apparently unoccupied, although adult Black-and-chestnut Eagles are observed regularly nearby, according to people from the local community (E. Ramos pers. comm.). The nest was situated on the edge of a forested corridor connected to a larger patch of continuous dense natural forest, in a 22-m tall emergent tree (species unknown) that measured 0.76 m dbh and was at 2561 masl. The nest was located 16 m high in the tree, in a fork of one primary and two secondary branches, where the angle of the main branch supporting the nest was 105°. The nest measured 0.9 m × 1.4 m in width and length and 0.52 m in depth. Within the 0.5-ha area surrounding the nest tree, tree density was 78 trees/ha, and trees averaged 0.62 m ± 0.25 (SE) dbh. We did not collect data on canopy cover or slope at this site.

The Black-and-chestnut Eagle nest in Ecuador was found in 2013 in the Intag River Valley (0°19.894′N, 78°32.615′W) in Cotacachi in the province of Imbabura (P.

Jost pers. comm.). When we visited the nest on 10 January 2017, we found a juvenile that was approximately 6 mo old, having returned to the nest after fledging. We estimated the juvenile's age based on photos from other monitored nests in Colombia (S. Zuluaga unpubl. data). The nest tree was within a remnant forest patch that was a nest site known by the local community for at least 60 yr (J. Hidalgo pers. comm.). The nest tree was a 35-m tall emergent cecropia (*Cecropia telealba*) measuring 0.66 m dbh and was at 2241 masl. The nest was located approximately 30 m high in the cecropia tree, in a fork of one primary and five secondary branches, where the angle of the main branch supporting the nest was 90°. We estimated the nest measured 1.2 m × 1.5 m in width and length and 1 m in depth. Within the 0.5-ha area surrounding the nest tree, tree density was 2568 trees/ha, and trees averaged 0.29 m ± 0.14 (SE) dbh. We did not collect data on canopy cover or slope at this site.

The elevation range for nests of the Black-and-chestnut Eagle reported in Table 1 is between 1786 and 2561 masl, with the nest at Fomeque at the highest reported elevation. The density of trees around the occupied Black-and-chestnut Eagle nest tree was much lower at the nest in Gachalá than at the nest in Cotacachi. These differences may be related to the logging history of the forests surrounding the nests. The forest fragment surrounding the nest in Gachalá is composed of primary forest that has never been logged and thus has a high density of large trees, while forests in Cotacachi have suffered selective logging until recently, and thus are characterized by smaller, dense trees. At the unoccupied nest in Fomeque, forests suffered extensive logging; the nest tree was one of the few scattered trees left within a mostly open pasture, which might be the reason the nest was apparently unoccupied for several years.

The Harpy Eagle nest was found on 12 October 2016 by a native Embera guide (A. Cunampia) employed by the Jardín Botánico del Pacifico (JBP), in the municipality of Bahía Solano (6°13.354′N, 77°24.069′W) in the department of Chocó, Colombia. Three weeks later, the Embera guide found the adult female Harpy Eagle dead, on the ground approximately 30 m from the nest tree. JBP's managers contacted a tree climber to determine whether there was a nestling in the nest. On 10 November 2016, JBP's managers used a drone (DJI Phantom 4 Quadcopter) to observe the nest, which contained a live nestling. On 12 November 2016, we climbed to the nest and found a 1-wk-old nestling, dead. We determined the nestlings's age based on photos from other nests of this species in Brazil and from the authors' experience. This Harpy Eagle nest was located in a 40-m-high emergent Ceiba (*Ceiba pentandra*) tree that measured 3.31 m dbh. This nest tree was at 79 masl, among the lower elevational sites reported for Harpy Eagle nests in other regions (40–150 masl in Brazil, Aguiar-Silva et al. 2014; 50–310 masl in Panama, Vargas-Gonzales and Vargas 2011; 200–240 masl in Ecuador, Muñiz-López 2005, Muñiz-López et al. 2007; and 450 masl, Fowler and Cope 1964). The nest in Bahía Solano was 35 m high in the Ceiba tree, in a fork of three primary branches; the angle between the main supporting branch and the trunk was 63°. The nest measured 1.3 m × 1.4 m in width and length and 0.8 m in depth. Within the 0.5-ha area surrounding the nest tree, tree density was 635 trees/ha, and trees averaged 0.44 m ± 0.67 (SE) dbh, slope inclination was 3° and the slope faced WSW. We did not measure canopy cover at this site.

Regional and local forest raptor extinctions have been reported in Colombia as a consequence of human-driven historic and continuing forest loss and fragmentation within the Andean region (Renjifo 1999). Black-and-chestnut Eagles have been recorded in 22 Important Bird Areas (IBAs) in Colombia and in one IBA in Ecuador, and Harpy Eagles have been recorded in six IBAs in Colombia and five in Ecuador (BirdLife International 2017a, 2017b). However, no nest sites of either species are known within these designated IBAs in Colombia, where there are no proposals to declare new IBAs around currently known nests. In Ecuador, no nests of the Black-and-chestnut Eagle are located within IBAs, although one nest is within a private reserve in the Tungurahua Province (Table 1). In contrast, ten of the eleven Harpy Eagle nests from Ecuador are within the Cayapas-Santiago-Wimbí IBA (Muñiz-López et al. 2007). This general lack of protection of eagles' breeding territories is worrisome, because habitat destruction from logging, farming or mining are real threats for many of them (e.g., the Intag nest is within the boundaries of an open-pit gold-mining concession). Additional efforts are needed to locate and study more nests of these species to gain a wider knowledge about their breeding biology and nesting habitat and to further understand their conservation needs.

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