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Milvago chimachima in Costa Rica

Buteo plagiata in Texas, USA

Busarellus nigricollis in Costa Rica

Gampsonyx swainsonii in El Salvador

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Table of Contents

The NRN is a membership-based organization. Its goal is to aid the research and conservation of Neotropical raptors by promoting communication and collaboration among biologists, raptor enthusiasts, and other conservationists working in the Neotropics. To join please e-mail the NRN coordinator, Marta Curti, at mcurti@peregrinefund.org, stating your interest in Neotropical raptor research and conservation.

Symbiotic behavior between *Milvago chimachima* and *Iguana iguana* in Pavones, Costa Rica

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The Yellow-headed Caracara (*Milvago chimachima*) is a bird of prey of the falconiform order and falconidae family (Oriá et al., 2016). It is distributed through Central and South America, from Costa Rica to northern Argentina and southeastern Brazil (Stiles and Skutch 2007).

The Yellow-headed Caracara is a generalist species that tolerates ecosystems with some level of disturbance rates and is usually easily observed in open areas such as: grasslands, crop fields, savannas, scrub, on the banks of bodies of water, around roads and in urban areas, up to 1,500 meters above sea level (Stiles and Skutch 2007, De la Ossa and De la Ossa- Lacayo 2011).

In Costa Rica it can be found along the slopes of the south Pacific, central Pacific, north Pacific and in the Central Valley. However, the distribution of this species continues to grow within the country, due to the fact that *M. chimachima* is favored by the continuous fragmentation of the landscape - a result of the expansion of crop fields and pasture lands (Garrigues and Dean 2014, Vargas et al. 2014).

Like all falconiformes, the Yellow-headed Caracara is characterized by a strong and hooked beak, prehensile talons and highly developed visual acuity - traits which allow it to satisfy its hunting requirements (Alvarado and Roa, 2011). However, this species is distinguished from many other birds of prey due to its slower flying speed and flight pattern of shallow flaps, which makes it difficult for it to hunt aerially (Stiles and Skutch 2007, De la Ossa et al. 2018).

The Yellow-headed Caracara is an opportunistic, generalist and scavenger bird. It obtains most of its food on the ground, consuming dead animals,

Yellow-headed Caracara removing parasite from Green Iguana en Pavones, Costa Rica. Foto © ?

organic urban waste, corn, insects, tadpoles, crabs and turtles. There are also reports of predations on mice, small fish and some reptiles. Additionally, the Yellow-headed Caracara is also known for feeding on ectoparasites found on large mammals such as cattle and tapirs, creating a symbiotic relationship between different taxonomic classes (Bittioli et al. 2008, De la Ossa and De la Ossa-Lacayo 2011, Gonçalves et al. 2017).

This manuscript describes a symbiotic interaction between a Yellow-headed Caracara and a Green Iguana (*Iguana iguana*), in Pavones, Costa Rica (8º 20 '53 "N, 83º 07' 36" W). The event ocurred in a Ficus (*ficus sp)* tree approximately 15 m high, in an open landscape near the Pacific coast.

On 8 April, 2017 we witnessed an adult Yellow-headed Caracara perched on the back of an adult, male Green Iguana. The iguana moved slowly during the observation period, and the caracara remained on the reptile for a period not exceeding 25 minutes. The authors observed the Yellow-headed Caracara using its beak to feed on ectoparasites which it removed from the iguana on repeated occasions.

Dominant male Green Iguanas, as in this case, are more susceptible to acquiring ectoparasites as a result of the increase in their blood testosterone levels (Camacho and Pérez 2009). This occurs principally during periods of high sexual activity, which affect the status of the host (Camacho and

Pérez 2009). This "cleaning" behavior results in a benefit for both species. In addition, the authors did not observe any injuries at all to the iguana as a result of this event.

Among the various types of ecological relationships between species of different taxonomic classes, the symbiotic behavior between *Milvago chimachima* and *Iguana iguana* is completely new. For this reason, we consider it pertinent to share this new report in the literature.

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An Incident of Cartwheeling Interaction in the Gray Hawk (*Buteo plagiata*)

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Cartwheeling is the term established for the midair interaction between two raptors which draw near, grasp each other's feet and plummet downward, rotating around a central axis, before finally disengaging and parting. (Simmons and Mendelsohn 1993, Farquhar et al. 1994). In their assessment of these flights Simmons and Mendelsohn (1993) concluded that while some cartwheeling interactions were components of courtship, the majority of them were agonistic.

These rare incidents have been reported in old world and Nearctic raptors and have more recently been recorded in Neotropical species. (Ellis 1992, Farquhar et al. 1994, Seipke and Cabanne 2002, Figueroa Rojas 2003, Valdez and Osborn 2004, Hengstenberg and Vilella 2005, Méndez-Mojica 2012, Norambuena et al. 2012, Leveau 2013, Raimilla 2015, Brooks and Mayes 2016). This note documents cartwheeling in *Buteo plagiata*, the Gray Hawk.

The Gray Hawk is a Neotropical raptor that ranges from Costa Rica to southern and western Texas, southern New Mexico and southeastern Arizona (Bibles et al 2002). The cartwheeling interaction made basis of this note took place in the northern extreme of the hawk's distribution, approximately 0.6 km north of the Rio Grande River in Texas (N 26° 10' 8", W -98° 22' 50") during breeding season (Corman 2005, Patrikeev 2007).

On 26 March 2017 at 1124 hrs. our party observed four Gray Hawks soaring northeast of our position, approximately 250 meters distant. Two of these Gray Hawks broke away from the others and drifted slowly in our direction. As the duo soared over a dry oxbow lake we noted that one of them was a juvenile, which are rarely encountered in the company of adults during the breeding season. (RAG pers. obs.).

The hawks soared without incident for several minutes before the juvenile began to cross into the adult's flight path. The latter eased away and a few moments later the juvenile altered its own course, effectively following the adult. Upon regaining proximity, the juvenile proceeded to en-

Sequence of cartwheeling event between a juvenile and an adult Gray Hawk. Photos © Joaquin Galindo

croach upon the adult as it circled. After more than ten minutes of this manner of flight the adult swooped at the close-passing juvenile, repelling it. The juvenile circled around and reciprocated, causing the adult to veer away. Each of the Gray Hawks flew at the other once more in the course of their soaring.

In its final sortie, the juvenile dived on the adult from above with lowered legs and the adult responded by rolling over and presenting talons. No actual contact was made until some thirty seconds later when both hawks advanced, locked talons and cartwheeled downward. Visual contact was lost as the still-engaged hawks descended into the canopy of the surrounding riparian/thorn forest. However, less than ten seconds later the adult had regained height and was photographed soaring overhead on flexed wings.

The duration of the descent, as recorded in the image files, was at least four seconds. It should be noted that we encountered the juvenile in the same location one week later (confirmed by digital images of the streaking pattern on its front side), soaring in similarly close proximity to an adult. We observed this flight for as long as the hawks were visible and witnessed none of the behaviors described above.

While addressing the plumage of juvenile Gray Hawks, Dickey and Van Rossem (1938) make reference to "individuals which breed the first year." Thus it appears that for the Gray Hawk, cartwheeling interactions between juvenile and adults cannot be presumed to be agonistic. Considering the alternative in the case at hand, we can render no evidence of courtship since we lost sight of the hawks near the terminus of their descent and do not know if copulation followed. Although we heard no food begging vocalizations from the juvenile, it is conceivable that it was following the adult Gray Hawk in the interest of being fed, during which time it incited an agonistic sequence culminating in cartwheeling flight.

Acknowledgements

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First nesting record of Black-collared Hawk (*Busarellus nigricollis*) in Costa Rica

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Juvenile Black-collared Hawk being fed on 25 April 2017 in the RNVSMCN. Photo © Barnaby Romero Hernández

The Black-collared Hawk (*Busarellus nigricollis*) is a neotropical raptor with two known subspecies: *B. n. nigricollis* has a wide geographic distribution that encompasses southern Mexico through Central America, the Brazilian Amazon, Bolivia, Guyanas and Trinidad; and *B. n. leucocephalus* that inhabits Paraguay and northern Argentina with occasional sightings in Uruguay (Campbell-Thompson et al. 2012, Fajardo-Cascante and Villarreal-Orias, 2017, Ingels et al. 2016). This species prefers areas near wetlands, from sea level to 1,500 masl, including man-

Female Black-collared Hawk and nest in *Vochysia guatemalensis*, 4 November 2017 in the RNVSMCN. Photo © Javier Tenorio

groves, marshes, mature riparian forests, lagoons and rice plantations (Bierregaard et al. 2017, Global Raptor Information 2017).

In Costa Rica it is found in the northwest sector of the country, the southern Pacific, the north Atlantic and the Caribbean side in Tortuguero. It is considered a rare resident and is affected by habitat fragmentation, and is thus suffering population declines (Stiles and Skutch 1989, Campbell-Thompson et al. 2012, Fajardo-Cascante and Villarreal-Orias 2017).

Its diet includes mainly fish as well as insects, crustaceans, molluscs, snails, frogs, snakes, lizards, juvenile alligators, small wading birds and rodents (Stiles and Skutch 1989, Evangelista et al. 2011, Ingels et al. 2016, Bierregaard et al. 2017).

Little is known about its reproductive biology and few nesting records exist throughout its distribution range (Di Giacomo 2000, Campbell-Thompson et al. 2012, Ingels et al. 2016). Here we present the first nesting records for the species in Costa Rica.

The Mixto Caño Negro National Wildlife Refuge [Refugio Nacional de Vida Silvestre Mixto Caño Negro] (RNVSMCN) is located in the Guatuzos Plains, Alajuela Province, in the northwest of the country near the border with Nicaragua. Its wetlands, with seasonal lagoons, are formed

mainly by the Frio River and to a lesser extent by the Mónico River. Annual precipitation in the area ranges between 2,500 and 3,500 mm with an average temperature and relative humidity of 25 °C and 80% respectively (Guerrero-Ortiz and Morazán-Fernández 2016).

Three Black-collared Hawk nests were located here in 2017. The first was observed on 25 April in a *Zanthoxylum* spp tree (10°53'41.9"N 84°46'01.9"W) approximately 20 m high. The nest was located 15 m from the ground. It contained a juvenile that was being fed by the parents. The second nest was observed on 3 May at 30 m from the ground in a *Ceiba pentandra* which was approximately 40 m in height (10°53'58.9"N 84°44'57.3"O). Finally, a third nest was observed in a *Vochysia guatemalensis* tree at 20 m high (10° 51'00.2"N and 84 ° 48'09.3" W) on 4 November. Both at this nest and in that of *C. pentandra*, the female was observed perched on the nest tree, jumping between adjacent trees and branches, vocalizing.

All three nests were large platforms made up of twigs and dry sticks in a secondary branch of each respective tree and were separated from each other by at least 3 km. They were all located at the edge of a seasonal lagoon with mature vegetation. We took measurements of the third nest using the ImageJ program. The nest diameter was 96 cm and approximately 75 cm high.

The data obtained on the breeding behavior of this species, such as biparental care, nest tree height, nest structure and duration of reproductive biology events, agree with those previously recorded in Argentina, Brazil and French Guiana (Di Giacomo 2000, Campbell-Thompson et al. 2012, Ingels et al. 2016). With the information gained coupled with that presented by Ingels et al. (2016) it is estimated that the reproductive period of *B. nigricollis* in Costa Rica lasts for 8-11 months, starting in the dry season, approximately at the end of January and ending around November when the juvenile is abandoned by the parents.

We believe it is important to carry out more studies on the reproductive biology of Black-collared Hawk and neotropical raptors in general. Currently there is a lack of information and scientific research to help increase our knowledge of birds of prey. More information will help us strengthen the conservation of and protection for these species, as we better understand how to maintain stable populations according to the biology of each species. Phillips (2012) and Camacho and Guerrero (2015) encourage the realization of studies regarding natural history, reproduction and habitat use. Likewise, continuous monitoring of the species is recommended to better understand its behavior during the reproductive cycle and other fundamental aspects of its ecology, range and parental care.

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Notes on nesting Pearl Kite (*Gampsonyx swainsonii*) in El Salvador

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The Pearl Kite (*Gampsonyx swainsonii*) is the latest raptor to arrive in El Salvador. The species was documented for the first time on 1 March, 2009, when a juvenile appeared in El Icacal Beach, Intipucá, department of La Unión (van Dorth et al., 2010). Since then, it has been registered a dozen times along the coastal plain in the departments of the central and eastern part of the country.

Deforestation in northern Colombia led to the expansion of the species into Panama (Ridgely and Gwynne 2005, Birdlife International 2018) and it has gradually established itself in Costa Rica (Martínez and Gastezzi 2016, Araya-Céspedes and Carbajal-Sánchez 2017, Sandoval et al., 2010, 2017). In Nicaragua, it has been defined as a rare resident in the Pacific and Central zones, with increasing populations (Martínez-Sánchez et al., 2014).

This population is considered part of the subspecies *G. swainsonii leonae* (Thiollay 1994), which is currently distributed from central and eastern El Salvador and southern Honduras (van Dorth et al., 2010) to northern Colombia , eastern Venezuela, Guyana and Suriname, as well as northern Brazil, Margarita Island, Trinidad and Tobago (Blake 1977). However, there are not many published records on this species' biology and most publications refer only to its range extension or prey base (Aguilar 1996, Araya-Céspedes and Carbajal-Sánchez 2017, Pineda et al., 2017).

Sandoval et al. (2010) recorded five Pearl Kite nests in Costa Rica, two on the Pacific coast and three on the Caribbean coast. All were located in wooded areas, close to human settlements and between 300 and 400 m away from water sources. A nest recorded by Pineda et al., (2017) was located approximately 120 m from human settlement and 850 m from the Jiboa river.

The pair constructing their nest, 21 January 2018. Photo © Néstor Herrera

On 21 January 2018, a nest was recorded at the edge of the CA-2 highway in the jurisdiction of El Rosario, department of La Paz, at 30 masl (13° 28' 25.1364" N and 89° 2' 24.108" W). The pair was observed carrying nesting material, including supporting branches, and arranging and exchanging positions in the nest, prior to egg-laying.

This nest was monitored via shared observations on the eBird platform. In total, 12 people observed the nest from 21 January to 28 March 2018, completing 67 days of observations, in intervals of 5 to 25 minutes of observation, for a total of 176 minutes (Table 1).

The pair nested in a *Pithecellobium dulce* tree (Leguminosae) that measured 16.5 m high and 50 diameters at breast height. The pair built the cup nest of twigs and sticks in the northeastern end of the tree, at 15 m high.

The nest tree was located on a small semi-wooded hill surrounded by pastures, sugar cane cultivations and human settlements, 20 m from the road and 120 m from the nearest home. The nest was located 2.3 km northwest of the nest recorded by Pineda et al. (2017) in March 2016.

On 28 January, the male was observed at the site with prey. He fed on a lizard (*Aspidoscelis deppeii*) and then called the female. She left the nest and perched on a Black Conacaste (*Enterolobium ciclocarpum*), about 25 m away. While the female fed, the male took her place in the nest.

Lt. **Pearl Kite Nestlings, 15 March 2018. Photo © Julio Acosta.** ***Rt.*** **Adult feeding its young, 15 February 2018. Photo © Néstor Herrera**

Between 27 January and 12 February 2018, the female was observed incubating the eggs and, later, protecting the young. On 15 February an adult was observed feeding the young, pulling strips of meat and passing it to the nestlings. Between 15 February and 15 March, the presence of two chicks became increasingly noticeable, as they were easily seen moving in the nest. One was quite developed with a short tail and the other with abundant down. One of the adults always stayed in the vicinity of the nest, while the other adult brought in food.

Though the incubation period for this species has not been recorded, in the similarly-sized (21 to 31 cm) American Kestrel (*Falco sparverius*), the incubation period is between 27 and 31 days and young remain in the nest 29-31 days (Thiollay 1994).

The pair of Pearl Kites was seen preparing the nest on 21 January and feeding chicks on 15 February, 26 days later. On 15 March, one month later, observers reported that complete plumage was visible on one of the nestlings, but the second nestling still had down. According to Thiollay (1994), the nestlings are fully feathered after 35 days. By 28 March, the young were no longer seen in the nest - 67 days had passed.

No re-occupation of the nest or reproductive behavior after the departure of the offspring was observed. Thiollay (1994) indicates that the species re-nests two or three weeks after the last young leaves the nest but this is doubtful. The nest recorded by Pineda et al. (2017) was occupied again in March 2017 (R. Alas, Com. Pers.).

Table 1. Observation records of nesting Pearl Kites in El Salvador, January – March, 2018

Date	Activity	Observation Time in minutess	Source
January 21	Nest construction	10	Sigüenza et al., 2018
January 22	Nest construction	10	Rivera & Andino 2018
January 27	Nest occupied	12	Miranda & Trejo 2018
January 28	Nest occupied Male bringing food to female	19	Miranda & Trejo 2018
January 28	Nest occupied, preening	5	Ábrego & Bonilla 2018
January 29	Nest occupied, male watching	5	Acosta 2018a
February 3	Nest occupied, male watching	5	Acosta 2018b
February 7	Adult in nest	6	Acosta et al., 2018
February 10	Adult in nest	5	Funes et al., 2018
February 12	Nest occupied, preening	6	Herrera & Galán 2018
February 15	Adult feeding the nestlings	7	Herrera & Galán 2018
February 27	Adult with two nestlings	5	Acosta 2018c
March 6	Adult with two nestlings	5	Acosta 2018d
March 8	Two adults, two nestlings, one of the nestlings fully feathered	25	Herrera 2018
March 10	Two adults, two nestlings, one of the nestlings fully feathered	37	Molina Fuentes 2018 Rivera 2018
March 15	Adult watching, two feathered nestlings	12	Acosta 2018e
March 28	Nest abandoned without signs of juveniles or adults arround	6	J. Acosta Obser. Pers.

Conclusion

This is the second nesting record of this species for El Salvador. The Pearl Kite is expanding its range in Central America and despite the gaps in information, it indicates a preference for wooded or semi-wooded sites, close to water sources and human settlements. It incubates the eggs between 25 and 30 days and the young leave the nest after 30-35 days. It is hoped that these observations will help define elements on the nesting and reproductive behavior of this species.

Sharing observations on the eBird platform is helping to increase our knowledge of avifauna, particularly in the case of raptors - as they are of great interest to the public who often seek them out. When amateur observers include details on bird behavior or add photographs and sounds, this promotes better levels of information for future studies and strengthens existing data.

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Captive conditions of raptors in three zoos in north Argentina

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In almost all the provinces of Argentina, there are sanctuaries, shelters, reserves, etc. where wild animals are exhibited. One of the most represented groups in these facilities are raptors. Despite the fact that there are many of these institutions across the country - many of which are the subject of some social discontent in regards to the conditions in which animals are kept and exhibited - Argentina does not have legislation regarding the minimum conditions in which to keep wild animals in captivity.

This means that many species of raptors, which are found in public and private zoos, are confined in inadequate enclosures in places with few or no rules for animal management or welfare.

In the following paper, we describe the conditions in which raptors are kept in three zoological institutions in northern Argentina: The Yatay Municipal Zoo in the province of La Rioja, the Dr. Carlos Pellegrini Phytozoological Reserve in the town of San Pedro de Colalao in the province of Tucumán, and the Rezool Ecological Reserve in San Pedro in the province of Jujuy. The objective was to check if the animals were kept in minimally appropriate conditions for their well-being.

Methodology

Through observations and photo documentation, we established some parameters for the conditions in which these birds are kept. These values were compared with those considered minimally appropriate for their maintenance in captivity. Seven minimum factors were established which, if optimal, can provide a better quality of life for the captive raptors:

1. Size of enclosures: Enclosures must be wide, long and high enough so that birds can make

A. **Rezool Ecological Reserve, small cage housing a Black-chested Buzzard Eagle, *B.* Yatay Municipal Zoo, large raptor aviary, *C.* Dr. Carlos Pellegrini Zoo, small raptor cages.**

horizontal and vertical flights, in order to exercise their muscles properly. Tall cages with raised perches allow the birds to perch higher, giving them a greater sense of security and a better observation point. The enclosures must also provide shelter against rain and sun (Setor de fauna wildlife department of biodiversidade secretaria do ambiente desenvolvimento sustentável 2016).

2. Perches: The perches must be placed in strategic positions so that the birds can take advantage of their locations during flight and rest. They must be of different sizes and easy to clean, and should be covered with insulating materials to prevent bumblefoot and other injuries (Fox 2009).

3. Bath pans: They must be wide enough to accommodate the size of each bird, so that it can easily enter and bathe safely. Bath pans should be as mobile as possible and made of easy-to-clean materials. If there is more than one bird in an enclosure, several baths must be placed, and the water must be changed daily.

4. Diet: The correct diet will be determined by the species, but it is recommended to incorporate foods more similar to those that can be found in nature, such as rats, quail, insects, snails, and fish, etc. (Ortiz et al, 2011, Ortiz et al 2013 and Ortiz 2016).

5. Individuals per cage: It is recommended to maintain one pair of raptors per cage (Baschetto 2000 and Wildlife Sector Department of Biodiversity Secretaria do Ambiente desenvolvimento sustentável 2016). If more than two birds are in the same enclosure, it is important to avoid housing together species with differing behaviors and ecological needs, as they may suffer aggression and competition for food.

6. State of individuals: (eye injuries, fractures, missing limbs, condition of the feathers, beak and talons): Ideally, individuals must be healthy and able to fly and feed without difficulty. However, if individuals do have injuries that hinder or impede their flight or diminish their motor or feeding capacity, falconry techniques must be

used, special enclosures must be built and these individuals should be handled differently in order to maintain their well-being (Fox 2000, Ortiz et al. Irwin et al., 2017).

7. Individual care (Filing of beaks and talons, feather care): Captive birds of prey often have overgrown beaks and talons, since, in most cases, captive conditions don't allow them to wear normally. It is important to regularly file their beaks and talons to keep them at a healthy length. (Fox 2009).

Results

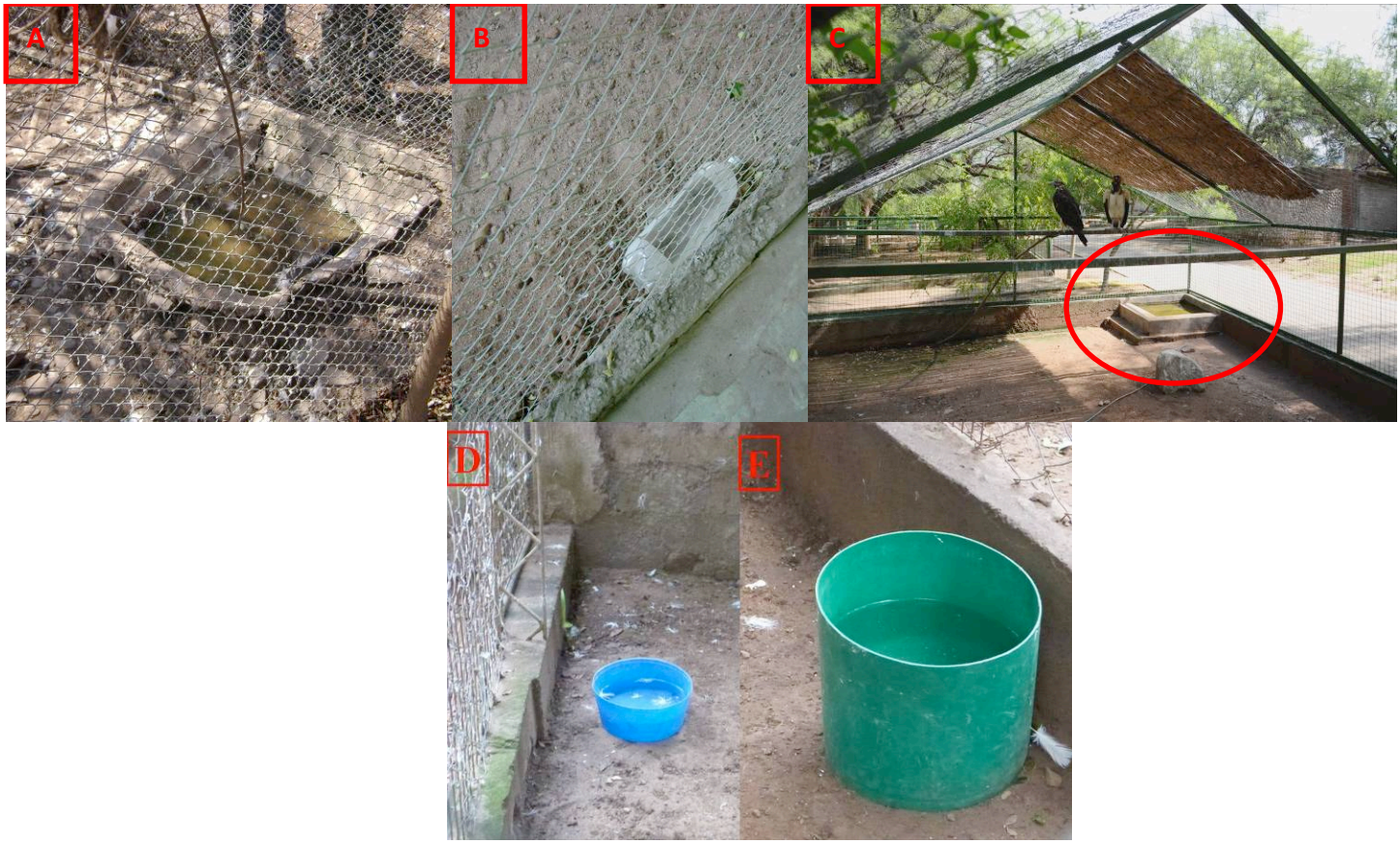
1. Size of enclosures: The enclosures varied widely among the different institutions. Enclosures at Yatay Municipal Zoo are very wide, giving the birds room to realize ample flights. This was also observed in the large raptor enclosure at the Dr. Carlos Pellegrini Zoo, although this zoo also has other raptors in very small cages where extensive flights are not possible. The Rezool Reserve has very small enclosures with low roofs, limiting the birds' flight.

2. Perches: In all three institutions the perches were placed in random, not well-thought-out spots within the enclosures. They appeared quite old because of their deteriorated state and the accumulation of fecal matter. None of the three institutions used insulating materials on the perches to protect the birds' legs and feet.

3. Bath pans: The bath pans were either made of cement or plastic. Those at Yatay were made of cement and filled with clean water. In the other two institutions, the bath pans and water were very dirty. Some were too small for birds to bathe in.

4. Diet: In the Dr. Carlos Pellegrini Zoo, the birds were mainly fed beef - in chunks or on the bone. At the Reezool Ecological Reserve birds were mainly fed chicken wings. The food was placed directly on the floor where the birds' fecal matter had accumulated. We could not determine what food was used at the Yatay Zoo.

<u>Perches</u> *A, B.* Dr. Carlos Pellegrini Zoo, *C.* Yatay Municipal Zoo, D. Rezool Ecological Reserve.



Bath pans: ***A, B.*** **Dr. Carlos Pellegrini Zoo,** ***C.*** **Yatay Municipal Zoo,** ***D and E.*** **Drinking pans for Black-chested Buzzard Eagle and King Vulture, Rezool Ecological Reserve.**

5. Individuals per cage: The large cages in both the Dr. Carlos Pellegrini Zoo and the Yatay Zoo house a variety of species, although of similar sizes, but with totally different behaviors. They also have individual cages where there are just one or two individuals. In Jujuy the birds were alone in individual cages.

6. State of individuals: In the three institutions most of the raptors lacked injuries that would prevent them from a normal life. However, some individuals did have different degrees of physical disabilities, such as a missing eye, amputated extremities, poorly-healed fractures, etc. Both healthy and injured individuals were housed all together in communal cages.

7. Individual care: All birds had excessive growth of beak and talons, and dirty and broken feathers.

Discussion

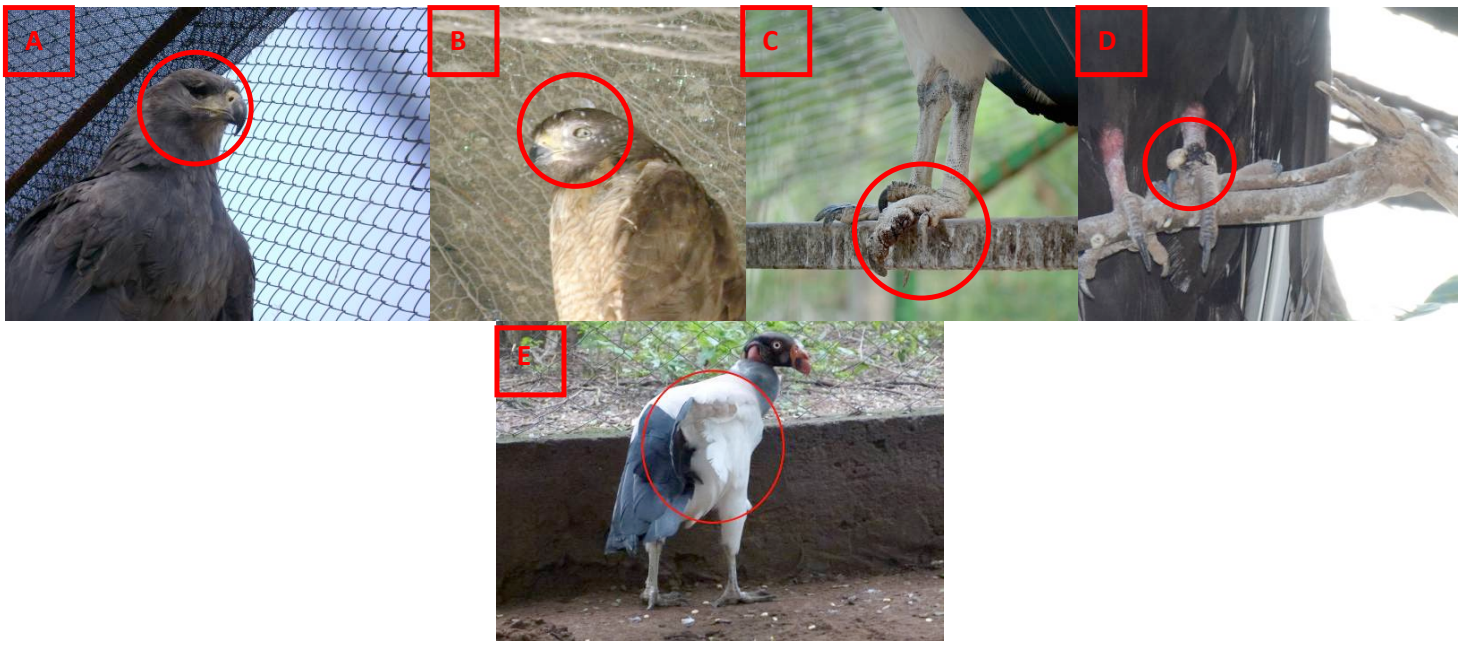
Based on our observations, these three institutions do not appear to comply with the basic measures we consider necessary for safely housing birds in captivity. While there are large cages in the Dr. Carlos Pellegrini Zoo and the Yatay Municipal Zoo, as recommended (Baschetto 2000, and Wildlife Sector Department of Biodiversity of the Environment Sustainable Development Secretariat 2016), the high number of birds in each enclosure makes them inadequate and thus,

negatively influences the welfare of individuals housed there. The coexistence of different species of birds with different lifestyles and ecology, as well as a mix of healthy individuals, together with individuals with injuries that prevent them from flying, shows a lack of knowledge of management of captive raptors. These conditions create competition for food so that more aggressive, territorial healthy birds eat first, making it difficult for the less dominant, less aggressive, or injured birds to reach the food quickly.

Inadequate nutrition in quantity and quality can produce malnutrition, obesity, and an imbalance of micro and macro nutrients (mainly in developing birds), causing serious health problems. Additionally, poorly maintained beaks and talons can influence a raptor's ability to feed.

Maintaining the hygiene of the enclosures is essential to maintaining healthy conditions for the individuals housed, since the accumulated dirt (fecal material, leftover food, etc.), can be a vector for infectious and parasitic diseases (Cubas, 2014). Appropriate perches are also extremely important, since inadequate perches can cause bumblefoot (Fowler, 2012). If to each of the factors mentioned above we add permanently stress-

Above. **Diet *A, B* Dr. Carlos Pellegrini Zoo, Birds fed with beef, *C.* Rezool Reserve, chicken wings.**
Below. **Multi-species cages. *A.* Dr. Carlos Pellegrini Zoo, *B.* Yatay Municipal Zoo.**



<u>Injured individuals</u> *A, B.* Crowned Solitary Eagle and Roadside Hawk at Dr. Carlos Pellegrini Zoo. *C, D.* King Vulture and Turkey Vulture at Yatay Zoo. E. King Vulture at Rezool Ecological Reserve.

ful conditions (which can cause different immunosuppression issues), it is clear that the health of individuals will be compromised. Therefore, the existence of a comprehensive management plan is necessary.

Unfortunately, these institutions also lack plans for raptor conservation. Many of the captive birds appear to be in good enough physical condition that, with health and behavioral evaluations, they could potentially be rehabilitated and returned to their natural environment..

These insitutions are also missing out on an opportunity to act as environmental education centers. None of them post guides or informative posters explaining the role of raptors in nature, their threats and why these individuals are in captivity.

We recommend that the provincial bodies that authorize these zoological institutions collaborate with institutions that carry out conservation studies, education, rehabilitation and release of birds of prey in Argentina. This could help to greatly improve the conditions of these captive birds of prey, and would go a long way in improving the management and care of this group of birds and would provide the expertise necessary to evaluate the possibilities of their rehabilitation and release.

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Birds of prey at Quebrada González sector, Braulio Carrillo National Park, Costa Rica

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Raptors are predatory birds that include diurnal and nocturnal species such as falcons, hawks, eagles, vultures and owls (Marquez et al. 2005). Some of these species have broad diets, while others are highly specialized as reflected in their morphology (beak shapes, talon size, etc.).

These birds hunt and feed on insects, dead animals and vertebrates such as amphibians, reptiles, mammals, fish and birds (Marquez et al. 2005). Raptors are a key component in ecosystems because they occupy the top level of the food chain and therefore play an important role as biological controllers (De la Ossa-Lacayo and De la Ossa 2011).

Many species of raptors have large home ranges and require expansive suitable areas of habitat, a situation that makes some species very sensitive to habitat fragmentation and degradation (Martínez et al. 2003). This has caused some raptors to become vulnerable due to the high deforestation rate and habitat losses that have occured in the past few decades across the globe (Rullman and Marzluff 2014). Therefore, it is important to expand efforts into raptor research to better understand their habits and their distribution, which could be a key factor into raptor management and conservation.

One way to learn more about the habits and habitats of these animals is through studies that show the diversity and distribution of species within a particular site (Piana and Marsden 2012). This is essential for adequate conservation and management since it allows us to know the composition of species in an area, helping us to assess whether there are threatened species as well as generating important information about the habitats being used (Piana and Marsden 2012). This can lead to the protection of key areas for the conservation of these animals.

In Costa Rica, there is a great diversity of raptors,

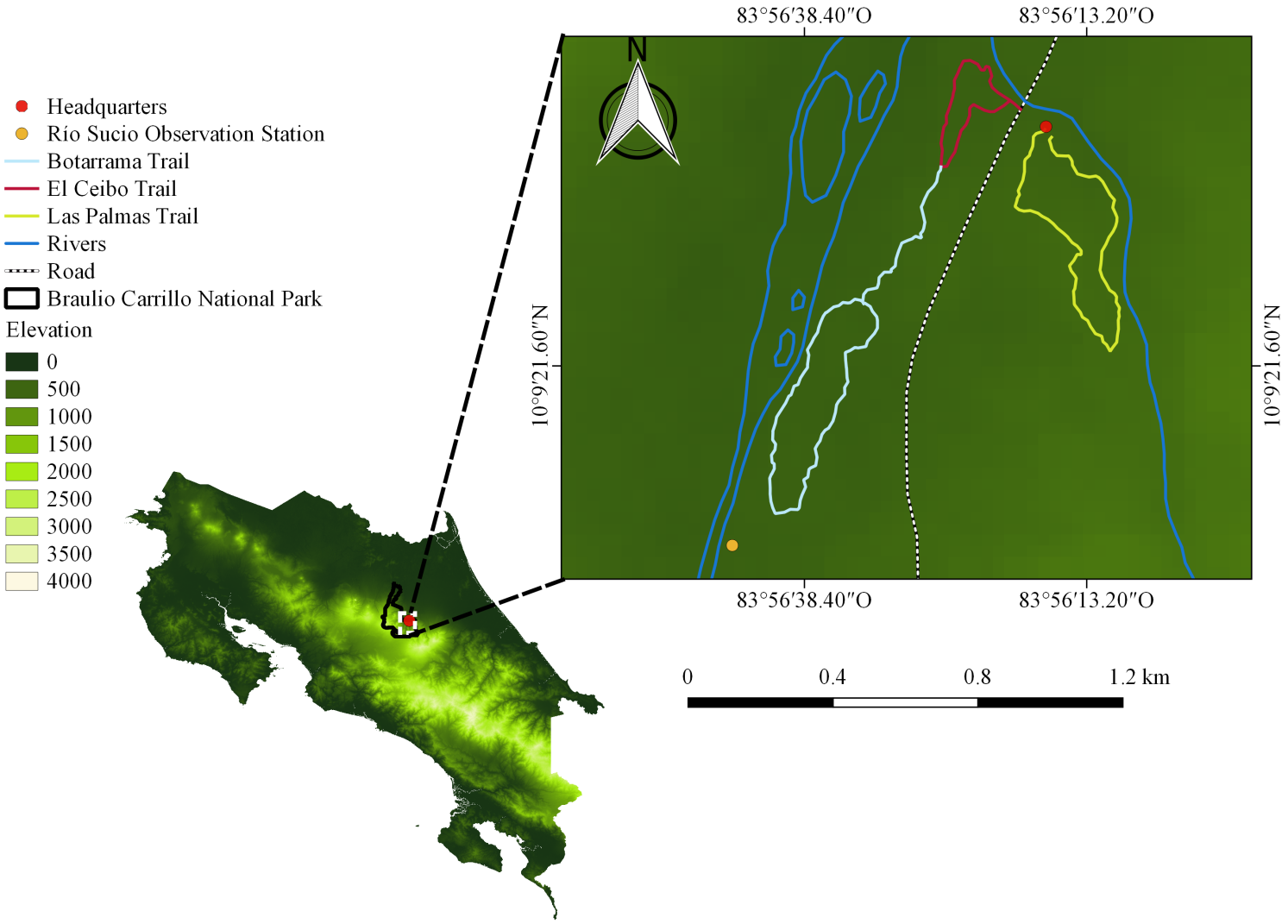

Figure 1. **Study site map in Quebrada González Sector of Braulio Carrillo National Park, Costa Rica, 2012-2015 period.**

with a total of 74 species grouped into six families: Accipitridae, Cathartidae, Falconidae, Pandionidae, Tytonidae and Strigidae (Garrigues et al. 2015). The availability of these data is due to the efforts of different authors that have made species lists, diversity studies and field trips in various parts of the country (Blake and Loiselle 2000, Blake and Loiselle 2001, Stiles and Skutch 2007, Garrigues et al. 2015).

These efforts have helped us to understand raptor community composition at different sites and within different life zones of the country, as well as the distribution of these species in Costa Rica.

However, some areas in Costa Rica have not been studied, and the raptor community in those sites is unknown. The Quebrada González sector of Braulio Carrillo National Park, the largest and one of the better conserved parks of the volcanic Cordillera Central, is one such area. Therefore, the objective of this study was to determine the raptor richness in the Quebrada González sector of Braulio Carrillo National Park.

Materials and methods

Study site: The Braulio Carrillo National Park is a protected area of approximately 50,000 ha and a landscape with an altitudinal range from 35 m at Puerto Viejo of Sarapiqui up to 2,906 meters at the Barva Volcano (Bermúdez et al. 2013). Four life zones can be found in this national park: Tropical Wet Forest, Tropical Premontane Rain Forest, Lower Montane Rain Forest and Montane Rain Forest (Timm et al. 1989). The park's administration is divided into four sectors: Barva, Ceibo, Zurquí and Quebrada González (Bermúdez et al. 2013). The Quebrada González sector (10° 09' 39.88" N and 83° 56' 13.97" W) is located in a Tropical Wet Forest (premontane transition) at Pococí, Limón, Costa Rica, and it contains three habitat types: mature forest, secondary forest and pasture (Lücking 1999, Oviedo-Perez and Fournier-Gutierrez 2008, Vasquez-Acosta 2009). The annual rainfall can reach up to 6,375 mm with an average temperature of 25°C and the elevation ranges from 433 to 595.7 m (Oviedo-Perez and Fournier-Gutierrez 2008). Access to this sector is possible along the following trails: Las Palmas (1.5 km), El Ceibo (1.0 km) and Botarrama (2.5 km).

Data collection: Between February 2012 and February 2015, we performed monthly visits consisting of 3-day field trips, with a total of 37 field trips and 111 total days of field work. During each field trip, we did day-time and night-time surveys, for a total of 111 diurnal surveys and 74 nocturnal surveys (Ralph et al. 1996). Also, we surveyed from an observation station next to Río Sucio riverbed (10° 8' 53.00" N and 83°56'50.91"W) on multiple occasions. Overall, we conducted 296 person-hours during night-time surveys and 444 person-hours during day-time surveys, for a total of 740 person-hours during our study period.

Our sampling technique consisted of searches along transects on the forest trails and point counts from an observation station in Rio Sucio riverbed (Ralph et al. 1996). Diurnal raptor species were identified by direct observation while perched in the forest or while in flight from the observation station.

Owls were identified by direct observation and by their calls; the latter requiring the use of recordings of Costa Rica's owls. We recorded every species of hawk, falcon, vulture and owl, observing them with 10 x 42 binoculars and photographing them. We followed Garrigues and Dean (2007) and Garrigues et al. (2015) for the identification and taxonomy of the observed species.

Results

We recorded a total of 16 raptor species corresponding to four families. These data represent approximately 22% of raptor species in Costa Rica. Resident species such as the Black Vulture (*Coragyps atratus*) and the Turkey Vulture (*Cathar-*

Table 1. **Birds of prey registered in Quebrada González sector, Braulio Carrillo National Park, Costa Rica, 2012-2015. (Relative abundance: A = abundant, more than 100 individuals. C = Common, more than 50 individuals but less than 100. U = Uncommon, more than 5 individuals but less than 50. R = rare less than 5 individuals). (Status: R = Resident, M = Migratory).**

Taxa	Status	English name	Spanish name (Costa Rica)	Abundance
Cathartidae				
Coragyps atratus	R	Black Vulture	Zopilote Negro	A
Cathartes aura	R,M	Turkey Vulture	Zopilote Cabecirrojo	A
Sarcoramphus papa	R	King Vulture	Zopilote Rey	U
Accipitridae				
Elanoides forficatus	R,M	Swallow-tailed Kite	Elanio Tijereta (Gavilán Tijereta)	C
Ictinia plúmbea	R,M	Plumbeous Kite	Elanio Plomizo	R
Pseudastur albicollis	R	White Hawk	Gavilán Blanco	U
Buteo platypterus	R,M	Broad-winged Hawk	Gavilán Aludo (Gavilán Pollero)	A
Buteo swainsoni	M	Swainson's Hawk	Gavilán de Swainson	A
Spizaetus ornatus	R	Ornate Hawk-Eagle	Aguilucho Penachudo	R
Buteogallus urubitinga	R	Great Black Hawk	Gavilán Negro	R
Strigidae				
Pulsatrix perspicillata	R	Spectacled Owl	Búho de Anteojos (Oropopo)	U
Lophostrix cristata	R	Crested Owl	Búho Penachudo	U
Pseudoscops clamator	R	Striped Owl	Búho Listado	U
Falconidae				
Herpetotheres cachinnans	R	Laughing Falcon	Guaco	R
Falco peregrinus	M	Peregrine Falcon	Halcón Peregrino	U
Falco rufigularis	R	Bat Falcon	Halcón murciélago	R

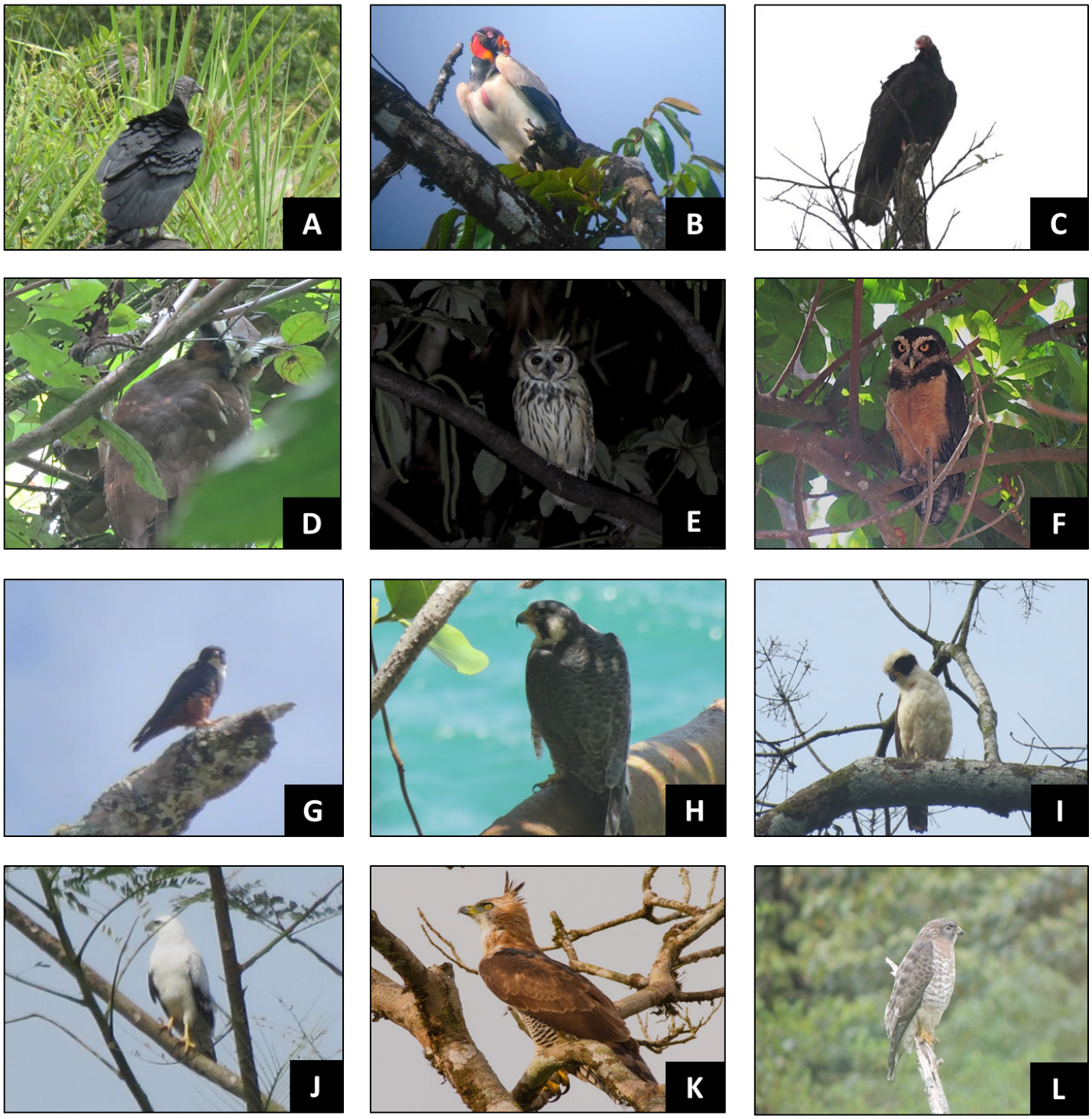

Figure 2. **Some birds of prey present in Quebrada González sector, Braulio Carrillo National Park, Costa Rica, 2015-2017. Black Vulture (A), King Vulture (B), Turkey Vulture (C), Crested Owl (D), Striped Owl (E), Spectacled Owl (F), Bat Falcon (G), Peregrine Falcon (H), Laughing Falcon (I), White Hawk (J), Ornate Hawk-Eagle (K) and Broad-winged Hawk (L). Photographs by Alejandro Zúñiga-Ortiz, Daniel Ramírez-Arce, Iván Catillo-Gómez and Ronald Jiménez-Saborío.**

tes aura) were the most abundant throughout the time of sampling. However, big groups of more than 200 individuals of migratory species such as Broad-winged Hawk (*Buteo platypterus*), Swainson's Hawk (*Buteo swainsoni*) and some individual Peregrine Falcons (*Falco peregrinus*) were observed during the migration season. Small groups of 3-7 individuals of Swallow-tailed Kite (*Elanoides forficatus*) were observed flying over during the study time. Rare species like Plumbeous Kite (*Ictinia plumbea*) and Bat Falcon (*Falco rufigularis*) were observed one time and not registered again, and a couple of Ornate Hawk-Eagles (*Spizaetus ornatus*) were observed nesting on the Las Palmas trail in a *Vochisia ferruginea* tree. A Laughing Falcon (*Herpetotheres cachinnans*) was heard in the forest but was not observed.

Of the three species of owls we found, only the Spectacled Owl (*Pulsatrix perspicillata*) was both observed and heard during the study. The Crested Owl (*Lophostrix cristata*) and Striped Owl (*Pseudoscops clamator*) were heard several times during the study period.

Discussion

The Quebrada González sector of Braulio Carrillo National Park offers an ideal place for raptor diversity. It has a Tropical Wet Forest (premontane transition) life zone with an elevation that ranges from 433 to 595.7 m and is dominated by mature and secondary forest (Oviedo-Pérez and Fournier-Gutierrez 2008). According to Blake and Loiselle (2000, 2001), the greater bird richness (including raptors) is found in forests between 50 m - 1000 m in elevation, and secondary growths, which could explain the richness we found in Quebrada González sector. However, a greater richness has been found in the lowlands at La Selva Biological Station (a protected area close to the park with an elevation of 200 m) where a total of 55 raptor species could be present (Zook et al. 2012).

In the study performed by Blake and Loiselle (2000) a total of five species of raptors were found at 500 m of elevation, one nocturnal and four diurnal – eleven less than we reported. Oviedo-Pérez and Fournier-Gutierrez (2008) characterized the composition of birds in Quebrada González, and they reported a total of nine raptors, of which four species - Costa Rican Pygmy-Owl (*Glaucidium costaricanum*), Barred Forest-Falcon (*Micrastur ruficollis*), Semiplumbeous Hawk (*Leucopternis semiplumbea*) and Gray Hawk (*Buteo plagiatus*), were not observed in this study. This means that the number of raptors could rise to 20 species in the Quebrada González sector.

As for the migratory species, we observed groups of Broad-winged Hawks, Swainson's Hawks and Peregrine Falcons in two migratory seasons from the Río Sucio Observation Station. The observations corresponded to the migration seasons for raptors in Costa Rica: fall (August - December) and spring (March - June) (Ramírez-Alán et al.

2014), in which more than 5 million raptors that nest principally in North America migrate to Central and South America using the Mesoamerican Corridor (Porras-Peñaranda et al. 2004). According to some authors, this corridor is used by at least 32 of the 104 species of neotropical raptors (Bildstein and Zalles 2001, Bildstein and Duncan 2003, Porras-Peñaranda et al. 2004, Ramírez-Alán et al. 2014), who use forested areas such as Braulio Carrillo National Park to rest and feed during migration (Haines et al. 2003).

Additionally, during fall migration, counters recorded more than three million individual raptors including the Turkey Vulture, Broad-winged Hawk and Swainson's Hawk from the Kèköldi Observatory in the Cordillera de Talamanca. These three species represent about 98% of recorded raptors, the other 2% correspond to 13 species of migratory raptors (Porras-Peñaranda et al. 2004, Ramírez-Alán et al. 2014). Furthermore, Broad-winged Hawks have been reported to have a traveling distance of about 7,000 km during fall migration and some individuals can stay in the wintering areas for one season or more in Central and South America (Haines et al. 2003). This explains why the Turkey Vulture, the Broad-winged Hawk and the Swainson's Hawk were the most abundant species we observed.

Finally, we found that the occurrence of owl sightings – both visual and auditory - was low. Some authors suggest that when and how often owls vocalize correlates with the activity of other species, but also with season, environmental conditions, moon phase and illumination. These studies also suggest owl populations have changed through time (Enríquez-Rocha and Rocha 1995, Enríquez-Rocha and Rangel-Salazar 2001, Sigel et al. 2006). Although in this study the moon phase and activity of prey was not considered, these may have influenced the frequency of owl observations.

Implications for conservation

In Costa Rica, there have been decreases in the distribution of some birds of prey in forested areas, which is related to poor food availability and habitat loss (Sandoval 2009). For example, the Ornate Hawk-Eagle has decreased in abundance during the last 40 years in the rainforest, and the Harpy Eagle (*Harpia harpyja*) has become extremely rare in the Osa Peninsula in Costa Rica (Barrantes et al. 2002, Vargas et al. 2006, Garrigues and Dean 2007, Garrigues et al. 2015). The Harpy Eagle, the Crested Eagle (*Morphnus guianensis*) and the Solitary Eagle (*Buteogallus solitarius*) have not been reported in the Sarapiquí region since 1999 (Sigel et al. 2006; Zook et al. 2012), and some species like the Orange-breasted Falcon (*Falco deiroleucus*) and Aplomado Falcon (*Falco femoralis*) have been registered only a few times in the country in the last 25 years (Barrantes et al. 2002, Vargas et al. 2006, Garrigues and Dean 2007, Garrigues et al. 2015).

Therefore, Braulio Carrillo National Park is an important place for raptor diversity and conservation. It contains around 50,000 ha of continuous forest along an altitudinal gradient (Bermúdez et al. 2013) that provides a great amount of resources and water supplies, which makes it an excellent habitat for resident species of raptors that fly above the canopy to hunt and who use emergent trees for nesting (Titus and Mosher 1981). Also, this area is part of the migration route for Swainson's Hawks, Peregrine Falcons and Broad-winged Hawks (Haines et al. 2003).

For the reasons mentioned above, the protection of areas like the Braulio Carrillo National Park is key for the maintenance of raptor diversity and for the preservation of stop-over spots used by migratory species. Furthermore, it is essential to carry out more research related to the genetic and ecological aspects of these species as this will give us greater understanding of the species found in these sites, and thus allow us to take appropriate measures regarding conservation and management. In addition, it is vital that there be continuous monitoring over time to assess how species richness can vary and if climate change has any effect in terms of diversity and migration routes.

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Of Interest...

Conferences

Annual Meeting of the Raptor Research Foundation & Neotropical Raptor Network Conference

4-8 October 2020, Boise, Idaho, USA
www.raptorresearchfoundation.org/conferences/upcoming-conferences/

The year 2020 is just around the corner and The Peregrine Fund is excited to host you at the 2020 Annual Meeting of the Raptor Research Foundation and the Neotropical Raptor Network!

The Peregrine Fund will be celebrating its 50th Anniversary that year and is working to make RRF2020 a true celebration of raptor science and conservation.

Conference hosts include The Peregrine Fund, Boise State University, Intermountain Bird Observatory, Golden Eagle Audubon, and USGS Idaho. Conference co-chairs are Sarah Schulwitz, Director of the American Kestrel Partnership, and Rick Watson, President and CEO of The Peregrine Fund. For any questions please contact Sarah at Schulwitz.Sarah@peregrinefund.org or Marta at mcurti@peregrinefund.org.

Grants

Cornell Lab of Ornithology
https://mail.google.com/mailu/2/#inbox/16564586951c52c3

The Cornell Lab of Ornithology cordially invites organizations and groups in Latin America and the Caribbean Islands to apply for mini-grants to support workshops for educators about birding, BirdSleuth curricula, Lab resources and citizen science; and/or to support community events, which integrate the arts, citizen science, and habitat creation or restoration. Mini-grants range from $250 to $2500 dollars (USD).

Neotropical Migratory Bird Conservation Act
www.birds.cornell.edu/landtrust/neotropical-migratory-bird-conservation-act-nmbca/

The matching grants program supports public-private partnerships carrying out noteworthy projects in the U.S., Canada, Latin America, and the Caribbean. While most conservation activities that benefit Neotropical migratory birds are eligible, land protection, habitat restoration, community outreach, and education, as well as bird research and monitoring, may all be of special interest to land trusts.