

# Diet of Ornate Hawk-Eagle (*Spizaetus ornatus*)

Fagner Daniel Teixeira<sup>1,5</sup>, Elisa Paraíso Mesquita<sup>2</sup>, Michele Alves Ferreira<sup>3</sup> & Felipe de Carvalho Araújo<sup>4</sup>

<sup>1</sup> Avenida João Gonçalves Teixeira, 22, Bairro Glória, Carmópolis de Minas, MG, Brazil.

<sup>2</sup> Rua Coronel Pedro Jorge, 26, Bairro Prado, Belo Horizonte, MG, Brazil.

<sup>3</sup> Rua Gustavo da Silveira, 1000, Bairro Horto Florestal, Belo Horizonte, MG, Brazil.

<sup>4</sup> Departamento de Ciências Florestais, Universidade Federal de Lavras, Lavras, MG, Brazil.

<sup>5</sup> Corresponding author: fagnerdani@hotmail.com

Received on 12 November 2018. Accepted on 21 February 2019.

**ABSTRACT:** The Ornate Hawk-Eagle (*Spizaetus ornatus*) is a top predator and inhabits mainly preserved forests. It occurs from Mexico to Argentina and throughout Brazil, where it is threatened by extinction. It hunts birds, mammals and reptiles, picking up both on the ground and on the branches in the forest. Here we report data on a pair and one young individual of this species registered in the southeast of Minas Gerais state, eastern portion of the Espinhaço Range, Brazil. In addition, a literature review on the diet of the species was carried out aiming gather data on food habits. The nesting territory, as well as the nest was discovered in semi-deciduous seasonal forest area. We recorded predation of a Lesser Yellow-headed Vulture (*Cathartes burrovianus*) by the young. After two days of observation, the nest was overthrown, what allowed its screening for other food items discovered after analysis of some feathers and bones. Detailed records of predation of *S. ornatus* were non-existent or inaccurate. Taking together our own field observation and the literature review, we found 121 taxa consumed by *S. ornatus*. A total of 78 bird species were reported, mainly Galliformes, followed by medium-sized mammals (38 species), well represented by Rodentia and Primates.

**KEY-WORDS:** birds of prey, diet, nesting, predation, review.

## INTRODUCTION

The Ornate Hawk-Eagle *Spizaetus ornatus* is a large and imposing bird of prey from the family Acciptridae. The species' size ranges from 56 to 68.5 cm in length (Howell & Webb 1995) and 820 to 1272 g in body mass (Dunning-Jr. 2008). Ornate Hawk-Eagle occurs in rainforest, wetlands, riparian forests, seasonally deciduous and semi-deciduous forests, up to elevations of ~1800 m a.s.l. (Íñigo *et al.* 1987, del Hoyo *et al.* 1994, Ferguson-Lees & Christie 2001). Ornate Hawk-Eagle has a wide distribution, from Mexico to the northern of Argentina and Paraguay, including all Brazil (Ferguson-Lees & Christie 2001), but it is considered rare throughout its range, mainly in southern populations such as in northern Argentina and south-southeastern Brazil (Márquez *et al.* 2000).

Observations of birds of prey, like the large Ornate Hawk-Eagle, are difficult to get because of the low densities, shy behavior and closed forest preferences (Bibby *et al.* 1992). For these reasons, basic information of its life history is still poorly known (Robinson 1994, Naveda-Rodríguez 2004).

Despite Ornate Hawk-Eagle is often found in forest fragment edges and even in open degraded areas (Ferguson-Lees & Christie 2001) it needs preserved habitats for breeding (Lyon & Kuhnigk 1985). The combination of

habitat loss and low breeding rate has been threatening of extinction this species, with the populations decreasing throughout its occurrence area (Márquez *et al.* 2000). It is not a surprise that Ornate Hawk-Eagle is globally “Near Threatened” (BirdLife International 2016), and has been listed as threatened in several locations, such as Paraguay (del Castillo & Clay 2005). In Brazil, *S. ornatus* is “Critically Endangered” in the states of Rio Grande do Sul (Rio Grande do Sul 2014), São Paulo (Silveira *et al.* 2009), Espírito Santo (Simon *et al.* 2007) and Santa Catarina (CONSEMA 2011), and “Endangered” in Paraná (Mikich & Bérnills 2004), Rio de Janeiro (Alves *et al.* 2000) and Minas Gerais (Copam 2010).

The overall negative impacts of habitat changes in the distribution and in the reproduction of the species also affect feeding behavior. It is known that Ornate Hawk-Eagle hunts its prey in roosts on dense vegetation, including the edge and the interior of forests patches (Robinson 1994). Ornate Hawk-Eagle has fast flying attack to reach and capture the prey both in trees and on the ground (Trail 1987, Ferguson-Lees & Christie 2001). Prey include bird flocks such as egrets in nesting colonies (Hilty 2003), birds that feed in flocks (Kilham 1978, Robinson 1994), groups of birds in reproductive display such as Guianan Cock-of-the-Rock (*Rupicola rupicola*), and also mammals such as monkey groups (Hilty 2003). The literature shows that most of the food items of *S.*

*ornatus* consists of medium-sized mammals and large birds, which are frequently missing in forest due to the defaunation caused by human-induced fragmentation (Kurten 2013); and less frequently, reptiles (Klein *et al.* 1988). However, the published data is scarce and there are few studies with more detailed data (*e.g.*, Lyon & Kuhnigk 1985 and Madrid *et al.* 1992 in Guatemala, Klein *et al.* 1988 in Brazil, Clinton-Eitniew *et al.* 1991 in Belize, and Robinson 1994 in Peru). Understanding the diet of *S. ornatus* allow us to better planning actions for Ornate Hawk-Eagle conservation.

This study shows a new predation record by a young *S. ornatus* observed at the field. In addition, a data set was collected from the nest of Ornate Hawk-Eagle. Finally, we reviewed dietary records from published articles and unpublished data shared between researchers about Ornate Hawk-Eagle.

## METHODS

### Field observations

Observations and recordings were carried out in the Conceição do Mato Dentro, southeast Minas Gerais state, Brazil. The area is inserted in an ecotone between areas of Atlantic Forest and Cerrado Domains, located in the eastern portion of the Espinhaço Range (18°54.584'S; 43°25.596'W). The Atlantic Forest and the Cerrado are considered hotspots of biodiversity (Mittermeier *et al.* 2004), reflected in bird diversity, which have the highest number of threatened (54 species in the Atlantic Forest and 14 in the Cerrado) (Marini & Garcia 2005) and endemic species in Brazil (223 species in the Atlantic Forest and 29 in the Cerrado region) (Silva 1997).

Observations were carried out in semi-deciduous riparian forest areas and rocky outcrops at 816 m altitude. Because of the recent fragmentation, the area is a mosaic between forest fragments and open areas. In 07 April 2016, we observed a young *S. ornatus* resting on the ground in an open area, near the forest remnant. Two days later, an individual with adult plumage was found flying in thermals. Since then, those individuals were monitored to identify prey captured by the species. Through observations and monitoring the young *S. ornatus*, we discovered, at the same month, the nest between thick forks of Jatobá tree (*Hymenaea courbaril*) approximately 25 m height and about 300 m from the predation site.

On 01 June 2016 the tree nest was cut down (properly authorized by the competent organs), and we collected the nest with its content. At this moment the young had already abandoned the nest and its withdrawal could be done without causing direct damage to the birds. All biological material contained in the nest (bones

and feathers) was screened and identified with the help of specialists from the Natural History Museum of the Catholic University of Minas Gerais.

### Literature review

To review the available information of the diet of Ornate Hawk-Eagle, we consulted scientific articles (searched in Web of Science, Scirus, JSTOR and Scielo), unpublished information, and photographs from citizen science web-pages (*e.g.*, <http://www.wikiaves.com.br/>, <http://ibc.lynxeds.com/>, <http://www.ebird.org>). In these cases, authors were contacted to confirm information.

## RESULTS

### Field observation

On 07 April 2016, a young of *S. ornatus* was observed among the branches of a cut tree on the floor feeding an adult Lesser Yellow-headed Vulture (*Cathartes burrovianus*) (Fig. 1). On the next day the same bird was observed again feeding on the carcass in the same place, consuming all flesh and bones, leaving feathers.

In the following days, new predation records were observed. The same young was observed feeding on the rest of a mammal and at least two small birds at the same location of the previous record. However, it was not possible to identify species. In these latter cases the bird was feeding in the forest edge, between canopy branches.

The nest material collected revealed a higher consumption of birds. Five species of birds were identified by feather remains (*Penelope* sp., *Trogon surrucura*, *Patagioenas picazuro*, *Hydropsalis albicollis*, *Piaya cayana* and Strigidae). In addition, two jaws and one pelvic



**Figure 1.** Ornate Hawk-Eagle (*Spizaetus ornatus*) eating a Lesser Yellow-headed Vulture (*Cathartes burrovianus*) in 07 April 2016, in Conceição do Mato Dentro, southeast of Minas Gerais, Brazil. Photo author: Michele A. Ferreira.

bone were identified, both attributed to two individuals, one adult and one juvenile of Paraguayan Hairy Dwarf Porcupine (*Coendou spinosus*).

### Literature review

We gathered 23 papers, ten books, five records of unpublished information and photographs from citizen science and one conference abstract with some information on the species' diet. Most data were from observations of carcasses taken from nest, while other provided information about attacks and attempted predation events.

Taking together our own field observation and the literature review, we found 121 taxa consumed by *S. ornatus* (Table 1). The largest number of species (78 species) was birds, mainly Galliformes, followed by medium-sized mammals (38 species), well represented by Rodentia and Primates. Among the Squamata, there are few records of predation on *Iguana iguana* and some unidentified snakes and lizards.

## DISCUSSION

### Field observations

The young *S. ornatus* seems to feed on a dead individual, since no traces of predation were observed. Jones & Dorward (2014) recorded the “interaction” between *S. ornatus* and a bovine femur and suggested that the species may present scavenging behavior. However, since the young bird was observed again feeding on the carcass in the consecutive days, it is possible that the vulture was captured before the first record. This would explain the absence of traces of recent predation regarding that return-hunting behavior is rare among birds of prey (*e.g.*, Springer *et al.* 2011, Whitacre *et al.* 2012).

Detailed records of predation of *S. ornatus* are non-existent or inaccurate. Stiles & Skutch (1989) have already mentioned that the species “captures birds up size of guans or vulture”, and Sigrist (2006) mention that they “catch macaws, parrots, vultures, *Coragyps atratus*”. However, those authors did not provided details, probably referring

**Table 1.** Food items consumed by *Spizaetus ornatus* based in a literature review and based in the nest material from Minas Gerais, Brazil (current study).

Class/Order	Family	Species	Common name	Reference
<b>Aves</b>				
Tinamiformes	Tinamidae	<i>Crypturellus boucardi</i>	Slaty-breasted Tinamou	Whitacre <i>et al.</i> 2012
		<i>Crypturellus cinnamomeus</i>	Eastern Thicket Tinamou	Whitacre <i>et al.</i> 2012
		<i>Crypturellus obsoletus</i>	Brown Tinamou	Joenck <i>et al.</i> 2011
		<i>Crypturellus parvirostris</i>	Small-billed Tinamou	Greco <i>et al.</i> 2004
		<i>Crypturellus soui</i>	Little Tinamou	Flatten <i>et al.</i> 1989, Whitacre <i>et al.</i> 2012
		<i>Crypturellus</i> sp. ( <i>variegatus</i> or <i>soui</i> )	Tinamou	Klein <i>et al.</i> 1988
		<i>Crypturellus</i> sp.	Tinamou	Madrid <i>et al.</i> 1991, 1992
		<i>Tinamus major</i>	Great Tinamou	Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1991, 1992, Whitacre <i>et al.</i> 2012
		<i>Tinamus</i> sp. ( <i>major</i> or <i>guttatus</i> )	Tinamou	Klein <i>et al.</i> 1988
		unidentified Tinamou	Tinamou	Lyon & Kuhnigk 1985
Anseriformes	Anatidae	<i>Amazonetta brasiliensis</i>	Brazilian Teal	Greco <i>et al.</i> 2004
Galliformes	Cracidae	<i>Crax rubra</i>	Great Curassow	Russell 1964, Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1992, Phillips & Hatten 2013, Whitacre <i>et al.</i> 2012
		<i>Oreophasis derbianus</i>	Horned Guan	Gómez-de-Silva 2006
		<i>Ortalis garrula</i>	Chestnut-winged Chachalaca	Olrog 1985
		<i>Ortalis guttata</i>	Speckled Chachalaca	Sigrist 2006
		<i>Ortalis motmot</i>	Little Chachalaca	Klein <i>et al.</i> 1988
		<i>Ortalis ruficauda</i>	Rufous-vented Chachalaca	Friedmann & Smith-Jr. 1955
		<i>Ortalis vetula</i>	Plain Chachalaca	Lyon & Kuhnigk 1985, Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1991, 1992, Whitacre <i>et al.</i> 2012
		<i>Penelope obscura</i>	Dusky-legged Guan	Joenck <i>et al.</i> 2011

Class/Order	Family	Species	Common name	Reference
		<i>Penelope purpurascens</i>	Crested Guan	Kilham 1978, Lyon & Kuhnigk 1985, Madrid <i>et al.</i> 1992, Abadia & Navarro 2011, Whitacre <i>et al.</i> 2012
		<i>Penelope</i> sp. (cf. <i>jacuacu</i> )	Guan	Klein <i>et al.</i> 1988
		<i>Penelope</i> sp. (cf. <i>marail</i> )	Guan	Klein <i>et al.</i> 1988
		<i>Penelope superciliaris</i>	Rusty-margined Guan	Greco <i>et al.</i> 2004, Lucheti 2015
		<i>Penelope</i> sp. (cf. <i>superciliaris</i> or <i>obscura</i> )	Guan	This study.
	Odontophoridae	<i>Odontophorus capueira</i>	Spot-winged Wood-quail	Joenck <i>et al.</i> 2011
		<i>Odontophorus guttatus</i>	Spotted Wood-quail	Whitacre <i>et al.</i> 2012
	Phasianidae	<i>Gallus gallus</i>	Domestic chicken	Friedmann & Smith-Jr. 1955, Ffrench 1991, Robinson 1994
		<i>Meleagris ocellata</i>	Ocellated Turkey	Madrid <i>et al.</i> 1991, 1992, Phillips & Hatten 2013, Whitacre <i>et al.</i> 2012
Suliformes	Anhingidae	<i>Anhinga anhinga</i>	Anhinga	Greco <i>et al.</i> 2004
Pelecaniformes	Ardeidae	<i>Ardea alba</i>	Great White Egret	Teixeira 2015
		<i>Butorides striata</i>	Green-backed Heron	Aldes Lamounier, pers. comm.
Cathartiformes	Cathartidae	<i>Coragyps atratus</i>	American Black Vulture	Dickey & van Rossem 1938
Gruiformes	Psophiidae	<i>Psophia leucoptera</i>	White-winged Trumpeter	Robinson 1994
	Rallidae	<i>Aramides cajaneus</i>	Grey-necked Wood-rail	Robinson 1994, Whitacre <i>et al.</i> 2012
		<i>Gallinula chloropus</i>	Common Moorhen	Greco <i>et al.</i> 2004
		<i>Pardirallus nigricans</i>	Blackish Rail	Greco <i>et al.</i> 2004
		<i>Porphyrio martinicus</i>	Purple Gallinule	Robinson 1994
Columbiformes	Columbidae	<i>Columba</i> sp.	Pigeons	Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1991, 1992
		Columbidae ( <i>Columba</i> , <i>Leptotila</i> , or <i>Geotrygon</i> )	Pigeons and Doves	Whitacre <i>et al.</i> 2012
		<i>Geotrygon montana</i>	Ruddy Quail-Dove	Whitacre <i>et al.</i> 2012
		<i>Leptotila plumbeiceps</i>	Grey-headed Dove	Lyon & Kuhnigk 1985
		<i>Leptotila rufaxilla</i>	Grey-fronted Dove	Joenck <i>et al.</i> 2011
		<i>Leptotila verreauxi</i>	White-tipped Dove	Greco <i>et al.</i> 2004
		<i>Patagioenas picazuro</i>	Picazuro Pigeon	Greco <i>et al.</i> 2004, this study
		<i>Patagioenas speciosa</i>	Scaled Pigeon	Whitacre <i>et al.</i> 2012
Opisthocomiformes	Opisthocomidae	<i>Opisthocomus hoazin</i>	Hoatzin	Dornas & Pinheiro 2007, Robinson 1994
Cuculiformes	Cuculidae	<i>Piaya cayana</i>	Common Squirrel-Cuckoo	Joenck <i>et al.</i> 2011, this study
Strigiformes	Strigidae	<i>Megascops guatemalae</i>	Guatemalan Screech-Owl	Madrid <i>et al.</i> 1992, Whitacre <i>et al.</i> 2012
Caprimulgiformes	Caprimulgidae	<i>Hydropsalis albicollis</i>	Pauraque	This study.
Trogoniformes	Trogonidae	<i>Trogon surrucura</i>	Surucua Trogon	This study.
Coraciiformes	Alcedinidae	<i>Megaceryle torquata</i>	Ringed Kingfisher	Wetmore 1965
Piciformes	Ramphastidae	<i>Aulacorhynchus prasinus</i>	Emerald Toucanet	Abadia & Navarro 2011, Whitacre <i>et al.</i> 2012, Monroy-Ojeda <i>et al.</i> 2014
		<i>Pteroglossus castanotis</i>	Chestnut-eared Araçari	Leonardo Lopes pers. comm.
		<i>Pteroglossus torquatus</i>	Collared Araçari	Madrid <i>et al.</i> 1991, Phillips & Hatten 2013, Whitacre <i>et al.</i> 2012
		<i>Ramphastos cuvieri</i>	Cuvier's Toucan	Giudice 2007
		<i>Ramphastos sulfuratus</i>	Keel-billed Toucan	Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1991, 1992, Phillips & Hatten 2013, Whitacre <i>et al.</i> 2012
		<i>Ramphastos vitellinus</i>	Channel-billed Toucan	Klein <i>et al.</i> 1988

Class/Order	Family	Species	Common name	Reference
	Picidae	<i>Campephilus guatemalensis</i>	Pale-billed Woodpecker	Whitacre <i>et al.</i> 2012
		<i>Melanerpes</i> sp.	Woodpecker	Madrid <i>et al.</i> 1991
Psittaciformes	Psittacidae	<i>Amazona autumnalis</i>	Red-lored Amazon	Whitacre <i>et al.</i> 2012
		<i>Amazona farinosa</i>	Southern Mealy Amazon	Whitacre <i>et al.</i> 2012
		<i>Amazona</i> sp. (cf. <i>albifrons</i> )	Probably White-fronted Amazon	Whitacre <i>et al.</i> 2012
		<i>Ara macao</i>	Scarlet Macaw	Klein <i>et al.</i> 1988
		<i>Ara</i> sp.	Macaw	Robinson 1994
		<i>Ara</i> sp. (cf. <i>Orthopsittaca manilatus</i> )	Red-bellied Macaw	Klein <i>et al.</i> 1988
		<i>Aratinga</i> sp.	Parakeet	Robinson 1994
		<i>Brotogeris</i> sp.	Parakeet	Robinson 1994
		<i>Pionus</i> sp.	Parrot	Naveda-Rodríguez 2004
		Psittacidae ( <i>Pionus</i> or <i>Pionopsitta</i> )	Parrot	Whitacre <i>et al.</i> 2012
Passeriformes	Bombycillidae	<i>Ptilogonys caudatus</i>	Long-tailed Silky-Flycatcher	Acosta-Chaves <i>et al.</i> 2012
	Cotingidae	<i>Rupicola rupicola</i>	Guianan Cock-of-the-Rock	Trail 1987
	Tyrannidae	<i>Tyrannus melancholicus</i>	Tropical Kingbird	Souza 2013
	Corvidae	<i>Cyanocorax cyanopogon</i>	White-naped Jay	Luiz Trinchão pers. comm.
		<i>Psilorhinus morio</i>	Brown Jay	Whitacre <i>et al.</i> 2012, Flatten <i>et al.</i> 1989, Madrid <i>et al.</i> 1992
	Icteridae	<i>Cacicus cela</i>	Yellow-rumped Cacique	Robinson 1994
		<i>Dives dives</i>	Melodious Blackbird	Whitacre <i>et al.</i> 2012
	Icteridae	<i>Psarocolius montezuma</i>	Montezuma Oropendola	Whitacre <i>et al.</i> 2012
	Undetermined	Probably <i>Quiscalus mexicanus</i> or <i>Crotophaga sulcirostris</i>	Great-tailed Grackle or Groove-billed Ani	Whitacre <i>et al.</i> 2012
<b>Mammalia</b>				
Carnivora	Procyonidae	<i>Nasua narica</i>	White-nosed Coati	Madrid <i>et al.</i> 1991, 1992, Abadia & Navarro 2011, Whitacre <i>et al.</i> 2012
Chiroptera	Phyllostomidae	<i>Artibeus jamaicensis</i>	Jamaican Fruit-eating Bat	Whitacre <i>et al.</i> 2012
		<i>Artibeus</i> sp.	Fruit-eating Bat	Whitacre <i>et al.</i> 2012
		Unidentified Bats	Bat	Lyon & Kuhnigk 1985
	undetermined	Unidentified Bats	Bat	Madrid <i>et al.</i> 1991
		Unidentified Bats	Bat	Lyon & Kuhnigk 1985, Madrid <i>et al.</i> 1992
Didelphimorphia	Didelphidae	<i>Caluromys derbianus</i>	Central American Woolly Opossum	Madrid <i>et al.</i> 1992
		<i>Didelphis marsupialis</i>	Common Opossum	Klein <i>et al.</i> 1988
		<i>Didelphis</i> sp.	Opossum	Abadia & Navarro 2011
		<i>Marmosa mexicana</i>	Mexican Mouse Opossum	Whitacre <i>et al.</i> 2012
		<i>Metachirus nudicaudatus</i>	Brown Four-eyed Opossum	Klein <i>et al.</i> 1988
		<i>Philander frenatus</i>	Southeastern Four-eyed Opossum	Greco <i>et al.</i> 2004
Lagomorpha	Leporidae	<i>Sylvilagus brasiliensis</i>	Tapeti	Greco <i>et al.</i> 2004
Pilosa	Cyclopedidae	<i>Cyclopes didactylus</i>	Silky Anteater	Giudice 2007
	Myrmecophagidae	<i>Tamandua mexicana</i>	Northern Tamandua	Abadia & Navarro 2011

Class/Order	Family	Species	Common name	Reference
Primates	Callitrichidae	<i>Callithrix penicillata</i>	Black-pencilled Marmoset	Greco <i>et al.</i> 2004, Luiz Trinchão pers. comm.
		<i>Saguinus fuscicollis</i>	Saddleback Tamarin	Robinson 1994, Heymann 1990
		<i>Saguinus imperator</i>	Emperor Tamarin	Terborgh 1983
		<i>Saguinus martinsi</i>	Martin's Ochraceous Bare-face Tamarin	Cirino 2015
		<i>Saguinus mystax</i>	Moustached Tamarin	Heymann 1990
	Cebidae	<i>Saimiri boliviensis</i>	Bolivian/Peruvian Squirrel Monkey	Boinski <i>et al.</i> 2003
		<i>Saimiri oerstedii</i>	Black-crowned Central American Squirrel Monkey	Boinski <i>et al.</i> 2003
		<i>Saimiri sciureus</i>	Common Squirrel Monkey	Boinski <i>et al.</i> 2003, Lopes <i>et al.</i> 2015
		<i>Saimiri</i> sp.	Squirrel Monkey	Robinson 1994
Rodentia	Cricetidae	<i>Sigmodon</i> sp.	Cotton Rat	Naveda-Rodríguez 2004
	Dasyproctidae	<i>Dasyprocta azarae</i>	Azara's Agouti	Joenck <i>et al.</i> 2011, Meller 2015
		<i>Dasyprocta leporina</i>	Red-rumped Agouti	Naveda-Rodríguez 2004
		<i>Dasyprocta punctata</i>	Central American Agouti	Whitacre <i>et al.</i> 2012
		Dasyproctidae ( <i>Myoprocta</i> or <i>Dasyprocta</i> )	Agouti	Klein <i>et al.</i> 1988
		<i>Myoprocta</i> sp.	Acouchi	Klein <i>et al.</i> 1988
	Echimyidae	<i>Proechimys</i> sp.	Spiny Rat	Robinson 1994
	Erethizontidae	<i>Coendou mexicanus</i>	Mexican Hairy Dwarf Porcupine	Whitacre <i>et al.</i> 2012
		<i>Coendou</i> sp.	Porcupine	Klein <i>et al.</i> 1988
		<i>Coendou spinosus</i>	Porcupine	This study.
	Sciuridae	<i>Sciurus granatensis</i>	Red-tailed Squirrel	Naveda-Rodríguez 2004
		<i>Sciurus</i> sp.	Squirrel	Madrid <i>et al.</i> 1991, 1992
		<i>Sciurus yucatanensis</i>	Yucatan Squirrel	Phillips & Hatten 2013, Whitacre <i>et al.</i> 2012, Flatten <i>et al.</i> 1989
	Muridae	Unidentified rat	Rat	Flatten <i>et al.</i> 1989
	<b>Reptilia</b>			
Squamata	Colubridae	Colubridae	Unidentified snake	Robinson 1994
	Iguanidae	<i>Iguana iguana</i>	Common Green Iguana	Clinton-Eitniear <i>et al.</i> 1991, Luiz Trinchão pers. comm. Sidnei Dantas pers. comm.
	Teiidae	Unidentified lizard	Lizard	Klein <i>et al.</i> 1988
	undetermined	Unidentified lizard	Lizard	Klein <i>et al.</i> 1988
		Unidentified snake	Snake	Klein <i>et al.</i> 1988

to Dickey & van Rossem (1938), who, after dissecting the stomach of an adult *S. ornatus*, found rests of a monkey and fresh meat. Studying the area, the authors found a primate carcass near a Black-Vulture (*Coragyps atratus*) with back parts eaten. The authors then inferred that the vulture was killed by the eagle and partially eaten while feeding on the carcass of the monkey already killed a few days ago.

Among the collected material from the nest, only *Penelope* was found, species as large as the New World vultures (Dunning-Jr. 2008). The lack of other large bird

species could be because *S. ornatus* does not carry large prey, eating them directly on the ground (Whitacre *et al.* 2012). Thus, to the best of our knowledge, vulture could be considerate an unusual prey of the Ornate Hawk-Eagle and eating the carcass suggests food habitat changes.

#### Literature review and collected nest information

Ornate Hawk-Eagle is considered an opportunistic predator, capturing prey according to availability in the environment (Clinton-Eitniear *et al.* 1991). However,

in Guatemala, even in areas where large lizards are abundant, during seven years of study, there were no cases of predation of these species, indicating that *S. ornatus* is more specialist than thought (Whitacre *et al.* 2012).

In Manaus, Brazil, the consumption of 45 different prey was observed, of which 63.3% were identified as birds, 32.7% were mammals and only 4.1% were reptiles (Klein *et al.* 1988). Madrid *et al.* (1992) observed 83 prey in six nests, 38.5% mammals and 38.5% birds. In Guatemala, among 52 prey observed 40.4% were birds, 46.1% were mammals and 13.5% were not identified (Flatten *et al.* 1989). The same authors observed a different proportion of prey items in the diet of Ornate Hawk-Eagle years later: of the 325 items identified, 56.3% were birds (69.8% of the biomass) and 43.7% were mammals (30.2% of the biomass) (Whitacre *et al.* 2012). Among the items consumed, a predominance of large birds and medium-sized mammals was observed. Among birds, the most captured species was Cracidae (genus *Ortalis* and *Penelope*), Tinamidae and Ramphastidae (*Ramphastos*); among mammals, the medium rodents (*Sciurus* and *Dasyprocta*) predominated (Klein *et al.* 1988, Whitacre *et al.* 2012).

The preference by large birds and medium-sized mammals needs more attention. Deforestation could have indirect effects on Ornate Hawk-Eagle food diet, like the feeding on domestic animals such as chickens (Friedmann & Smith-Jr. 1955, French 1991, Robinson 1994).

It should be noted, however, that most reports on predation were from carcasses found in the nest. Thus, large prey consumed in the soil or small animals are possibly underestimated. According to Bednarz (1988), diet records based in nest material are biased towards larger prey items because smaller items are more likely to be distorted or fragmented beyond recognition, and are more difficult to find than larger bones.

The knowledge about the ecological behavior of this species is still scarce. In recent years the Ornate Hawk-Eagle populations have been declining in several places throughout its distribution (BirdLife International 2016). Among the species of *Spizaetus* genus, *S. ornatus* is one of the most affected by habitat losses and hunting leading to local extinctions (Canuto 2008). For Ornate Hawk-Eagle, conservation efforts should take into account food items used by birds. As demonstrated in the present survey, detailed records are non-existent or inaccurate and careful must be taken when using this information.

#### ACKNOWLEDGEMENTS

We are grateful to Aryanne Clyvia, Cristiane Casar, Flávia Nunes, Claudia Costa, Marcelo Ferreira Vasconcelos,

Bruno Garzon, Giancarlo Zorzin, André Hirsch, Fabiano Melo and Anthony Rylands for sample identification. We thank Karla Leal, Ana Paula Otoni and Willian Menq for useful feedbacks, discussion and manuscript revisions. Bruna Horta, Marcos Anjos and Luiz Otávio de Oliveira helped with field surveys. We thank Jamie Holfeltz and Renzo Giudice for data access. We are grateful to many volunteers for providing recorded information.

#### REFERENCES

- Abadia E.O. & Navarro C.J. 2011. Monitoramento de *Spizaetus ornatus* e outras aves de rapina na reserva particular "Arroyo Negro", México. *Spizaetus* 11: 2–5.
- Acosta-Chaves V., Granados-Rodríguez F. & Araya-Huertas D. 2012. Predation of Long-tailed Silky Flycatcher (*Phyllogonyx caudatus*) by Ornate Hawk-Eagle (*Spizaetus ornatus*) in a cloud forest of Costa Rica. *Revista Brasileira de Ornitologia* 20: 451–452.
- Alves M.A.S., Pacheco J.F., Gonzaga L.A.P., Cavalcanti R.B., Raposo M.A., Yamashita C., Maciel N.C. & Castanheira M. 2000. Aves, p. 113–124. In: Bergallo H.G., Rocha C.F.D., Alves M.A.S. & van Sluys M. (eds.). *A fauna ameaçada de extinção do estado do Rio de Janeiro*. Rio de Janeiro: Editora da UERJ.
- Bednarz J.C. 1988. Comparative study of the breeding ecology of Harris' and Swainson's Hawks in southeastern New Mexico. *Condor* 90: 311–323.
- Bibby C.J., Burges N.D. & Hill D.A. 1992. *Bird census techniques*. London: Academic Press.
- BirdLife International. 2016. *Spizaetus ornatus*. The IUCN red list of threatened species. <http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22696197A40380758.en> (Access on 13 November 2018).
- Boinski S., Kauffman L., Westoll A., Stickler C.M. Cropp S. & Ehmk E. 2003. Are vigilance, risk from avian predators and group size consequences of habitat structure? A comparison of three species of Squirrel Monkey (*Saimiri oerstedii*, *S. boliviensis*, and *S. sciureus*). *Behaviour* 140: 1421–1467.
- Canuto M. 2008. Observations of two Hawk-Eagle species in a humid lowland Tropical Forest reserve in central Panama. *Journal of Raptor Research* 42: 287–292.
- Cirino B. 2015. WA1958085, *Spizaetus ornatus* (Daudin, 1800). <http://www.wikiaves.com/1958085> (Access on 16 May 2016).
- Clinton-Eitnien J., Gartside M.R. & Kainer M.A. 1991. Ornate Hawk-Eagle feeding on Green Iguana. *Journal of Raptor Research* 25: 19–20.
- CONSEMA [Conselho Estadual do Meio Ambiente]. 2011. *Resolução Nº. 002/2011*. [http://www.fatma.sc.gov.br/upload/Fauna/resolucao\\_fauna\\_002\\_11\\_fauna.pdf](http://www.fatma.sc.gov.br/upload/Fauna/resolucao_fauna_002_11_fauna.pdf) (Access on 16 April 2019).
- COPAM [Conselho Estadual de Política Ambiental]. 2010. *Deliberação Normativa Nº. 147/2010*. <http://www.siam.mg.gov.br/sla/download.pdf?idNorma=13192> (Access on 16 April 2019).
- del Castillo H. & Clay R.P. 2005. *Atlas de las aves del Paraguay*. Asunción: Guyra Paraguay.
- del Hoyo J., Elliot A. & J. Sargatal. 1994. *Handbook of the birds of the world, v. 2 (New World vultures to Guinea-fowl)*. Barcelona: Lynx Editions.
- Dickey D.R. & van Rossem A.J. 1938. The birds of El Salvador. *Field Museum of Natural History, Zoological Series* 23: 5–601.
- Dornas T. & Pinheiro R.T. 2007. Predação de *Opisthocomus hoazin* por *Spizaetus ornatus* e de *Bubulcus ibis* por *Bubo virginianus* em Tocantins, Brasil. *Revista Brasileira de Ornitologia* 15: 601–604.
- Dunning-Jr. J.B. 2008. *Handbook of avian body masses*. Boca Raton: CRC Press.

- Ferguson-Lees J. & Christie D.A. 2001. *Raptors of the world*. Boston: Houghton Mifflin Company.
- Ffrench R. 1991. *A guide to the birds of Trinidad and Tobago*. Ithaca: Comstock Publishing Associates.
- Flatten C.J., Madrid J.A., Hernandez A. & Gerhardt R. 1989. Observations at the nest of an Ornate Hawk-Eagle, p. 69–79. In: Burnham W.A., Jenny J.P. & Turtley C.W. (eds.). *Maya Project Progress Report II*. Boise: The Peregrine Fund, Inc.
- Friedmann H. & Smith-Jr. F.D. 1955. A further contribution to the ornithology of northeastern Venezuela. *Proceedings of the United States National Museum* 104: 463–524.
- Giudice R. 2007. First nesting report of the Ornate Hawk-Eagle (*Spizaetus ornatus*) in Peru, p. 9–13. In: Bildstein K.L., Barber D.R. & Zimmerman A. (eds.). *Neotropical raptors*. Orwigsburg: Hawk Mountain Sanctuary.
- Gómez-de-Silva H. 2006. Mexico. *North American Birds* 60: 444–451.
- Greco M.V., Andrade M.A., Carvalho G.D.M., Carvalho-Filho E.P.M. & Carvalho C.E. 2004. *Callithrix penicillata* na dieta de *Spizaetus ornatus* (Aves: Accipitridae) em área de Cerrado no estado de Minas Gerais, p. 155–160. In: Mendes S.L. & Chiarello A.G. (eds.). *A primatologia no Brasil, v. 8*. São Paulo: Sociedade Brasileira de Primatologia.
- Heymann E.W. 1990. Reactions of wild tamarins, *Saguinus mystax* and *Saguinus fuscicollis*, to avian predators. *International Journal of Primatology* 11: 327–337.
- Hilty S.L. 2003. *Birds of Venezuela*. Princeton: Princeton University Press.
- Howell S.N.G. & Webb S. 1995. *A guide to the birds of Mexico and northern Central America*. Oxford: Oxford University Press.
- Íñigo E.E., Ramos M. & González F. 1987. Two recent records of Neotropical eagles in southern Veracruz, México. *Condor* 89: 671–672.
- Joenck C.M., Zilio F. & Mendonça-Lima A. 2011. First record of breeding of the Ornate Hawk-Eagle (*Spizaetus ornatus*) in southern Brazil. *Hornero* 26: 163–166.
- Jones S.E.I. & Dorward L.J. 2014. Possible scavenging behaviour in Ornate Hawk-Eagle *Spizaetus ornatus* in Amazonas, Brazil. *Revista Brasileira de Ornitologia* 22: 27–31.
- Kilham L. 1978. Alarm call of Crested Guan when attacked by Ornate Hawk-Eagle. *Condor* 80: 347–348.
- Klein B.C., Harper L.H., Bierragaard R.O. & Powell G.V.N. 1988. The nesting and feeding behavior of the Ornate Hawk-Eagle near Manaus, Brazil. *Condor* 90: 239–241.
- Kurten E.L. 2013. Cascading effects of contemporaneous defaunation on Tropical Forest communities. *Biological Conservation* 163: 22–32.
- Lopes G.P., Guimarães D.P. & Jaskulski A. 2015. Predation of *Saimiri cassiquiarensis* (Lesson, 1840) (Primates: Cebidae) by *Spizaetus ornatus* (Daudin, 1800) (Accipitriformes: Accipitridae) in the Brazilian Amazon. *Atualidades Ornitológicas* 186: 20.
- Lucheti W.D. 2015. WA2083911, *Spizaetus ornatus* (Daudin, 1800). <http://www.wikiaves.com/2083911> (Access on 16 May 2016).
- Lyon B. & Kuhnigk A. 1985. Observations on nesting Ornate Hawk-Eagles in Guatemala. *Wilson Bulletin* 97: 141–147.
- Madrid J.A., Madrid H.D., Funes S.H., Avila J.A., Botzoc R.G. & Ramos A. 1991. Reproductive biology and behavior of Ornate Hawk-Eagle in Tikal National Park, p. 92–113. In: Whitacre D.F., Burnham W.A. & Jenny J.P. (eds.). *Maya Project Progress Report IV*. Boise: The Peregrine Fund Inc.
- Madrid H.D., Madrid R.A., Echeverría J.R.C., Alvarez J.S.C., Rivera M.C., Avila W.E.M. & Cál A.R. 1992. Behavior and breeding biology of the Ornate Hawk-Eagle, p. 179–191. In: Whitacre D.F. & Thorstrom R.K. (eds.). *Maya Project Progress Report V*. Boise: The Peregrine Fund Inc.
- Marini M.A. & Garcia F.I. 2005. Bird conservation in Brazil. *Conservation Biology* 19: 665–671.
- Márquez R.C., Zalles J., Stubbs L. & Bildstein K.E.S. 2000. *Latin American Falconiformes Conservation Assessment and Management Plan*. Apple Valley: IUCN.
- Meller D.A. 2015. WA1703770, *Spizaetus ornatus* (Daudin, 1800). <http://www.wikiaves.com/1703770> (Access on 14 April 2016).
- Mikich S.B. & Bérnils R.S. 2004. *Livro vermelho da fauna ameaçada no estado do Paraná*. Curitiba: Instituto Ambiental do Paraná.
- Mittermeier R.A., Gil P.R., Hoffmann M., Pilgrim J., Brooks T., Mittermeier C.G., Lamoreux J. & Fonseca G.A.B. 2004. *Hotspots revisited: earth's biologically richest and most endangered ecoregions*. Mexico City: CEMEX.
- Monroy-Ojeda A., Gibert-Isern S. & Orantes-Abadía E. 2014. Monitoramento do sucesso reprodutivo do Gavião-de-Penacho (*Spizaetus ornatus*) em Arroyo Negro, Chiapas: gerando um estudo pioneiro de aves de rapina Neotropicais no México. *Spizaetus* 18: 2–7.
- Naveda-Rodríguez A. 2004. Contribution to the natural history of Ornate Hawk-Eagle *Spizaetus ornatus* (Daudin, 1801) and Great Black-Hawk *Buteogallus urubitinga* (Gmelin, 1788). *Revista de Ecología Latinoamericana* 11: 23–26.
- Olrog C.C. 1985. Status of wet forest raptors in northern Argentina, p. 191–197. In: Newton I. & Chancellor R.D. (eds.). *Conservation studies on raptors*. Cambridge: ICBP Technical Publication.
- Phillips R.A. & Hatten C.J. 2013. Nest observations on the Ornate Hawk-Eagle (*Spizaetus ornatus*) in Belize, Central America. *Boletín SAO* 22: 1–9.
- Rio Grande do Sul. 2014. Decreto Nº 51.797 de 08 de Setembro de 2014. <http://www.al.rs.gov.br/filerepository/repLegis/arquivos/DEC%2051.797.pdf> (Access on 18 April 2019).
- Robinson S.K. 1994. Habitat selection and foraging ecology of raptors in Amazonian Peru. *Biotropica* 26: 443–458.
- Russell S.M. 1964. A distributional study of the birds of British Honduras. *Ornithological Monographs* 1: 1–195.
- Sigrist T. 2006. *Aves do Brasil: uma visão artística*. São Paulo: Avisbrasiliis.
- Silva J.M.C. 1997. Endemic bird species and conservation in the Cerrado region, South America. *Biodiversity and Conservation* 6: 435–450.
- Silveira L.F., Benedicto G.A., Schunck F. & Sugieda A.M. 2009. Aves, p. 87–284. In: Bressan P.M., Kierulff M.C.M. & Sugieda A.M. (eds.). *Fauna ameaçada de extinção no estado de São Paulo: vertebrados*. São Paulo: Fundação Parque Zoológico de São Paulo.
- Simon J.E., Antas P.T.Z., Pacheco J.F., Efe M.A., Ribon R., Raposo M.A., Laps R.R., Musso C., Passamani J.A. & Paccagnella S.G. 2007. As aves ameaçadas de extinção no estado do Espírito Santo, p. 47–64. In: Mendes S.L., Passamani M. (eds.). *Livro vermelho das espécies da fauna ameaçada de extinção no estado do Espírito Santo*. Vitória: Instituto de Pesquisas da Mata Atlântica.
- Souza J.S. 2013. WA863163, *Spizaetus ornatus* (Daudin, 1800). <http://www.wikiaves.com/863163> (Access on 16 May 2016).
- Springer M.T., Nielsen C.K., Carver A.D. & Correa N.J. 2011. Harpy Eagle (*Harpia harpyja*) feeding behavior on a Brown-throated Three-toed Sloth (*Bradypus variegatus*). *Journal of Raptor Research* 45: 100–103.
- Stiles G. & Skutch A.F. 1989. *A guide to the birds of Costa Rica*. Ithaca: Cornell University Press.



- Teixeira S.A. 2015. WA1932260, *Spizaetus ornatus* (Daudin, 1800). <http://www.wikiaves.com/1932260> (Access on 16 May 2016).
- Terborgh J. 1983. *Five New World primates: a study in comparative ecology*. Princeton: Princeton University Press.
- Trail P.W. 1987. Predation and antipredator behavior at Guianan Cock-of-the-Rock leks. *Auk* 104: 496–507.
- Wetmore A. 1965. *The birds of the Republic of Panamá: Tinamidae (tinamous) to Rynchopidae (skimmers), Part 1*. Washington: Smithsonian Institution Press.
- Whitacre D.F., Madrid J.A., Madrid H.D., Cruz R., Flatten C.J. & Funes S.H. 2012. Ornate Hawk-Eagle, p. 203–233. In: Whitacre D.F. (ed.). *Neotropical birds of prey: biology and ecology of a forest raptor community*. Ithaca: Cornell University Press.

Associate Editor: Cristiano S. Azevedo.