THERYA NOTES 2022, Vol. 3 : 137-142 DOI: 10.12933/therya_notes-22-85 ISSN 2954-3614

Arthropofauna consumed by the Andean night monkey (*Aotus lemurinus*) in a forest fragment at the Cordillera Central Colombia

Artropofauna consumida por el mono nocturno andino (*Aotus lemurinus*) en un fragmento de bosque en la Cordillera Central de Colombia

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Arthropods are important food for primates such as night monkeys (*Aotus* spp.) because they provide easily digestible protein and fat. However, the record of their consumption has been underestimated due to the opportunistic nature of their capture and difficulties in identification. We describe arthropod consumption by a group of Andean night monkeys (*Aotus lemurinus*) in a fragmented forest in Colombia. Between March and June 2016, we collected scat samples from nocturnal monitoring and visits to the resting site from a group of 4 individuals of the Andean night monkey. We preserved the samples in 96 % alcohol and subsequently visualized them under a stereoscope. The scats were inspected for arthropod fragments that were later determined at the taxonomic level of order and family. In 12 of the 15 scats analyzed, we found 48 arthropod fragments, among which we classified 38 at the order level and 16 at the family level. In total, we identified 7 arthropod orders (6 insects and 1 arachnid) and 9 insect families (5 Coleoptera, 3 Hemiptera and 1 Hymenoptera). The orders with the highest number of fragments in the scats were Coleoptera (21), Hemiptera (5) and Orthoptera (5) and the families were Elateridae and Curculionidae with 5 and 4 numbers of fragments, respectively. We report for the first time the consumption of the order Isoptera, as well as 2 new families of Hemiptera (*i.e.*, Coreidae and Pentatomidae) and 5 families of Coleoptera (*i.e.*, Chrysomelidae, Coccinellidae, Curculionidae, Elateridae and Staphylinidae) in the diet of night monkeys (*Aotus* spp.). The large number of beetle fragments in the scats of Andean night monkeys could be due to the chitinous composition of their exoskeletons that makes them difficult to degrade. This study provides novel information on the variety of arthropods consumed by the Andean night monkey and compiles all the information on the consumption of this item for the entire genus.

Key words: Chitin; Coleoptera; Isoptera; scats.

Los artrópodos son alimento importante para primates como los monos nocturnos (*Aotus* spp.) debido a que proveen proteínas y grasas fáciles de digerir. No obstante, el registro de su consumo ha sido subestimado por la naturaleza oportunista de su captura y por las dificultades en la identificación. Describimos el consumo de artrópodos por parte de un grupo del mono nocturno andino en un bosque fragmentado de Colombia. Entre marzo y junio de 2016, recogimos muestras fecales a partir de seguimientos nocturnos y visitas al dormidero de un grupo de 4 individuos del mono nocturno andino (*Aotus* spp.). Preservamos las muestras en alcohol al 96 % y posteriormente las visualizamos a partir de un estereoscopio. Se inspeccionaron las heces en búsqueda de fragmentos de artrópodos que posteriormente fueron determinados a nivel taxonómico de orden y familia. En 12 de las 15 heces analizadas encontramos 48 fragmentos de artrópodos, de los cuales se clasificaron 38 a nivel de orden y 16 a nivel de familia. En total, identificamos 7 órdenes de artrópodos (6 insectos y 1 arácnido) y 9 familias de insectos (5 Coleoptera, 3 Hemiptera y 1 Hymenopera). Los órdenes con mayor cantidad de fragmentos en las heces fueron Coleoptera (21), Hemiptera (5) y Orthoptera (5) y las familias más frecuentes fueron Elateridae y Curculionidae con 5 y 4 fragmentos, respectivamente. Reportamos por primera vez el consumo del orden Isoptera, así como 2 nuevas familias de Hemiptera (*i.e.*, Coreidae and Pentatomidae) y 5 familias de Coleoptera (*i.e.*, Chrysomelidae, Coccinellidae, Curculionidae, Elateridae y Staphylinidae) en la dieta de los monos nocturnos (*Aotus* spp.). La gran cantidad de fragmentos de escarabajos en las heces del mono nocturno andino podría ser debido a la composición quitinosa de sus exoesqueletos que los hace difícil de degradar. Este estudio aporta información novedosa sobre la variedad de artrópodos consumidos por el mono nocturno andino y recopila toda la información sobre el consumo de este ítem para todo el género.

Palabras clave: Coleoptera; heces; Isoptera; quitina.

Primates must select a diverse array of feeding items in order to fulfil their energetic and nutritional requirements (Felton *et al.* 2009). Obtaining nutrients such as sugars, fats and proteins can be challenging, and primates must balance the consumption of different feeding sources based on their preferences and habitat-wide availability (Felton

et al. 2009). In particular, fruits are important sources of sugars and carbohydrates, while leaves and insects provide proteins not readily available in fruits. Arthropods are one of the most important feeding items of small and medium-bodied primates, partly because they provide proteins and fats easier to absorb compared to traditional foods such as fruits and leaves (Rothman *et al.* 2014; Bryer *et al.* 2015). Nonetheless, the systematic recording of feeding on arthropods might be underestimated due to the opportunistic nature of capturing them and the difficulties associated with identifying arthropod prey in arboreal primates (Pickett *et al.* 2012).

The diet of night monkeys (*Aotus* spp.) has been recorded for several species of this broadly distributed primate genus. Night monkeys rely on ripe and fleshy fruits, and complement their diet with flowers, leaves and arthropods (Puertas *et al.* 1992; Fernandez-Duque 2007; Wolovich *et al.* 2010; Guzmán *et al.* 2016; Bustamante-Manrique *et al.* 2021; Montilla *et al.* 2021) and occasionally with small vertebrates and bird eggs (Puertas *et al.* 1992). Studies on night monkeys living both in the field and in captivity have recorded a few arthropod orders in their diet. For example, in a study on *Aotus azarae,* they were observed preying on Hemipterans (Fernandez-Duque 2007), while *A. nigriceps* has been observed eating several arthropods orders including Araneae, Coleoptera, Hymenoptera, Lepidoptera and Orthoptera (Wright 1985, 1986). In captivity, *A. nancymaae* was recorded eating both flying and crawling insects (Blattodea, Coleoptera, Diptera and Lepidoptera) as well as spiders (Araneae) and millipedes (Diplopoda; Wolovich *et al.* 2010). Castaño *et al.* (2010) observed *A. lemurinus* consuming arthropods of the orders Araneae, Hemiptera and Lepidoptera, and Grajales-Suaza *et al.* (2021) recorded the consumption of beetles (Coleoptera) of the genus *Phyllophaga*. Although most authors who have described the diet of night monkeys have reported arthropod consumption (Wright 1986; Arditi 1992; Puertas *et al.* 1992; Castaño *et al.* 2010; Wolovich *et al.* 2010, Guzmán *et al.* 2016; Bustamante-Manrique *et al.* 2021; Montilla *et al.* 2021), none have been able to establish quantitative estimates of this item within the diet (Fernandez-Duque 2007) mainly because of the challenges imposed by the nocturnal and arboreal nature of these primates, which makes it difficult to determine the arthropods consumed.

The Andean night monkey (*Aotus lemurinus*) is distributed in the Andes mountains of Colombia, Ecuador, and Venezuela between 1,000 and 3,200 m (Link *et al.* 2021). It has been recorded in primary and secondary forests, as well as in small degraded forest fragments, coffee plantations and forests immersed within urban areas (Castaño *et al.* 2010; Defler 2010; Montilla *et al.* 2017). Currently, this species is considered as Vulnerable according to the International Union for Conservation of Nature (IUCN), due to habitat loss and forest fragmentation, mainly as a result of agricultural and illicit crops expansion (Link *et al.* 2021). In the last decade, the diet of *A. lemurinus* has been described by Castaño *et al.* (2010), Guzmán *et al.* (2016), Bustamante-Manrique *et al.* (2021) and Montilla *et al.* (2021) who have recorded that they spend approximately between 12 % of their feeding time foraging and eating arthropods. However, none of these previous studies has provided a detailed account of arthropods consumed by night monkeys. Here, we describe the consumption of arthropods by the Andean night monkey in a fragmented forest of the Andes Central Cordillera of Colombia, providing novel information on their dietary habits.

This study was carried out in a fragmented forest known as Bosque de Las Martejas located at El Billar farm, in the municipality of Pijao, Quindío, Colombia (4° 19' 58" N, 75° 42' 39" W; 1,750–1,800 m). This forest which extends over approximately 6 ha is immersed in a complex mosaic of small forest fragments and banana, coffee, and avocado plantations. The forest canopy has a height of approximately 25 m and retains the typical characteristics of an Andean forest with large trees such as the genus *Poulsenia* and *Ficus* as well as pioneer trees of the genus *Cecropia* and *Miconia*. Within the forest, there are also several groupings of bamboo (*Guadua angustifolia*) that cover approximately 10 % of the entire fragment. Between March and June 2016, we collected scat samples from a single group of Andean night monkeys consisting of 4 individuals (*i.e.*, an adult male, an adult female and a subadult and a juvenile, both of undetermined sex). Scats were obtained from nocturnal monitoring of the group of monkeys, or directly at their resting sites (Figure 1). For nocturnal monitoring, we followed the night monkeys at least once a week during the entire sampling period, taking advantage of the hours of greatest activity proposed for these primates (*i.e.*, between 18:00 and 21:00 hr and between 03:00 and 06:00 hr; Castaño *et al.* 2010) and when weather conditions permitted. Samples were collected and preserved in 2 mL Eppendorf tubes with 96 % alcohol. Subsequently, we inspected all the fragments from the samples under the stereoscope (Zeiss Stemi dv4) in the laboratory of Universidad del Quindío and used the field guide of Snodgrass (1993) to identify arthropods contained in each sample to the highest taxonomic category.

Overall, we analyzed 15 scat samples, from which we found arthropod fragments in 12 of them. Based on the visual inspection of scat samples, we were able to identify 48 arthropod body parts (*e.g.*, legs, wings, antennae, exoskeletons), and taxonomically classify 38 of them at the order level and 16 at the family level.

We identified 7 orders of arthropods (6 insects and 1 arachnid) in Andean night monkey scat samples. We report for the first time the consumption of termites (order Isoptera), in the feeding ecology of night monkeys (*Aotus* spp.; Table 1; Figure 2a). The order with the highest number of fragments in the scats was Coleoptera (43.8 %), followed by Hemiptera (10.4 %) and Orthoptera (10.4 %). We found 9 different insect families (5 Coleoptera, 3 Hemiptera and 1 Hymenoptera) in the diet of the Andean night monkey (Table 2). The beetles' families Elateridae and Curculionidae

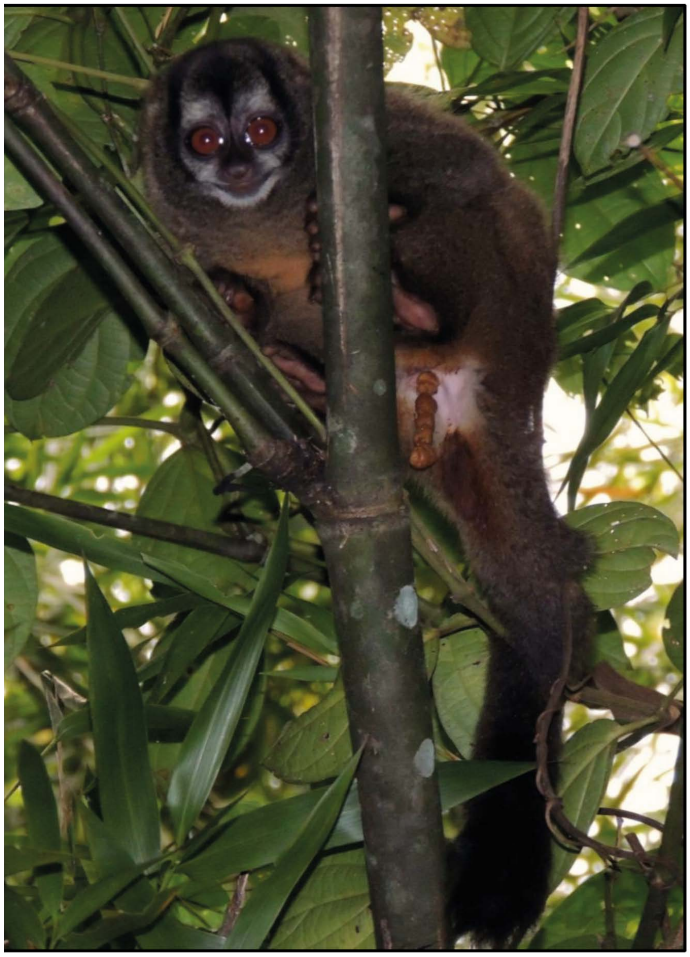

Figure 1. Andean night monkey, *Aotus lemurinus*, defecating at Bosque de Las Martejas of Pijao, Colombia.

(Figure 2b-c) had the highest number of fragments with 10.4 % and 8.3 %, respectively. The remaining orders and families were represented in less than 8 % of the fragments found in the samples.

The results of this study highlight how Andean night monkeys include a wide variety of arthropods in their diet. Despite our small sample size of scats, we detected the consumption of at least 7 arthropod orders and 9 families. Six of the arthropod orders recorded in our study have been also reported in the diet of night monkeys, including the Andean night monkey (Wright 1986, 1994; Fernandez-Duque 2007; Castaño *et al.* 2010; Wolovich *et al.* 2010; Bustamante-Manrique *et al.* 2021; Grajales-Suaza *et al.* 2021; Montilla *et al.* 2021). Earlier studies have documented the consumption of cycads (Hemiptera), which belong to the family Cicadellidae (Fernandez-Duque 2007; Castaño *et al.* 2010) and other studies report the consumption of beetles of the genus *Phyllophaga*, which belong to the family Scarabaeidae (Coleoptera; Grajales-Suaza *et al.* 2021) as well as ants of the family Formicidae (Hymenoptera; Wright 1985, 1994). In our study, we detected the consumption of Cicadellidae insects and added 2 new families of Hemiptera (*i.e.*, Coreidae and Pentatomidae) and 5 families of Coleoptera (*i.e.*, Chrysomelidae, Coccinellidae, Curculionidae, Elateridae and Staphylinidae) in the diet of Andean night monkeys. It is likely that the number of families and orders of arthropods consumed by Andean night monkeys and other night monkey species will increase from studies that include longer time series, ideally a year as well as a larger number of night monkey groups that inhabit forests with different degrees of anthropogenic impact.

Although Coleopterans are the most abundant insects in our samples, the high number of fragments found in the scats of the Andean night monkey may be a biased result inherent to the roughness and challenge to degrade their exoskeleton (Lambert 1998). Among insects, beetles are one of the groups that have more chitin in their exoskeletons, a very difficult compound to degrade that would require longer retention times in order to facilitate microbial fermentation and break down of this polysaccharide (Lambert 1998; Janiak 2018). The composition of the exoskeleton of these arthropods could explain why so many fragments remain intact after passing through the gastrointestinal tract of Andean night monkeys (Zeale *et al.* 2010). Indeed, based on observations in the scats of another nocturnal primate species in Madagascar (*Cheirogaleus medius*), it was evidenced the preference for the consumption of the order Coleoptera (Hladik *et al.* 1980); however, when performing DNA metabarcoding analysis, they found up to 32 different families that had not been found before in the scats (Rowe *et al.* 2021). Additionally, it has been suggested that the order Coleoptera has the highest abundances at ground level compared to the middle and upper canopy

Table 1. Comparison of the orders of arthropods consumed by night monkey species, *Aotus* spp.

Order of Arthropods	Species					
	A. azarae **(Fernandez-Duque 2007)**	***A. nigriceps*** **(Wright 1985, 1986)**	***A. nancymae*** **(Wolovich *et al.* 2010)**	***A. lemurinus*** **(Castaño *et al.* 2010)**	***A. lemurinus*** **(Grajales-Suaza *et al.* 2021)**	***A. lemurinus*** **(This study)**
Araneae		X	X	X		X
Blattodea			X			
Coleoptera		X	X	X	X	X
Diptera			X			X
Diplopoda			X			
Hemiptera	X			X		X
Hymenoptera		X				X
Isoptera						X
Lepidoptera		X	X	X		
Orthoptera		X				X

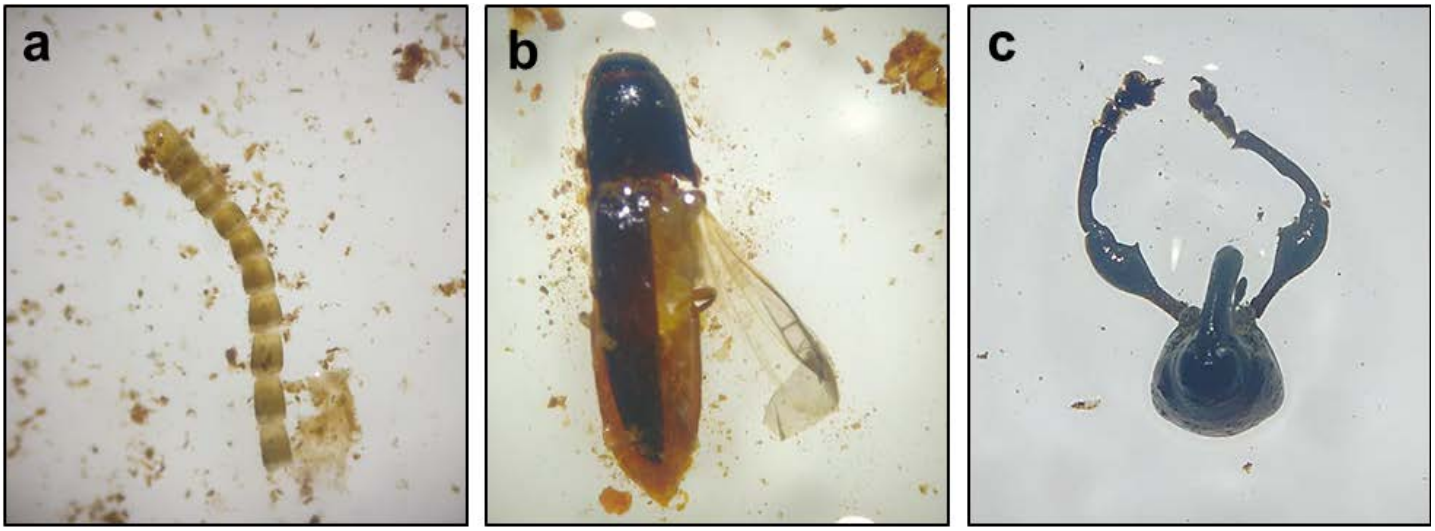

Figure 2. Fragments of arthropods found in the scats of the Andean night monkeys, *Aotus lemurinus*. a) Isoptera (the moniliform antennae are typical of terminate), b) Elateridae (Coleoptera), and c) Curculionidae (Coleoptera).

in tropical forests (Sutton and Hudson 1980; Sutton *et al.* 1983; de Souza *et al.* 2022), so that consumption of large amounts of beetles is unlikely because night monkeys forage mainly in a middle stratum (Wright 1994). Further, few studies have attempted to study the influence of arthropod availability in the canopy on the diet of primate species (Bryer *et al.* 2015; Fonseca *et al.* 2019); however, future studies should include these different approaches that improve our understanding of the feeding ecology and dietary preferences of primate species.

A similar pattern of detection bias in scats could occur with the order Hemiptera, which together with the order Orthoptera, ranked second in the number of fragments found in Andean night monkey scats. In this sense, it has been suggested that the order Hemiptera may also be more easily detected in scats (Zeale *et al.* 2010). However, this order may have a high abundance at upper canopy levels in tropical forests (de Souza *et al.* 2022) where Andean night monkeys move frequently during the night (Wright 1994). Despite the possible bias of higher detection of the order Coleoptera and Hemiptera in the scats of the Andean night monkey, these orders have been frequently recorded in the diet of different species of night monkeys including the Andean night monkey from field observations (Wright 1985; Fernandez-Duque 2007; Castaño *et al.* 2010; Grajales-Suaza *et al.* 2021).

Studies on the Andean night monkey have shown that it is mainly frugivorous, but they complement their diet with arthropods being the second most important dietary element for this species (Castaño *et al.* 2010; Montilla *et al.* 2021). The benefits of including arthropods in their diet are very high; because insects have a high protein and fat content compared to other sources such as leaves (Rothman *et al.* 2014; Bryer *et al.* 2015). It is important to note that these benefits could be reflected only if the consumption of arthropods is higher due to their small size of them. In *A. azarae* it has been suggested that nutritional levels obtained from the number of insects consumed could influence the reproductive seasonality (Fernandez-Duque *et al.* 2002; Rothman *et al.* 2014). However, the availability of arthropods can vary among different forest types, influencing the foraging strategies that the monkeys must use in order to find and eat this resource (Fernandez-Duque 2007; Fernandez-Duque *et al.* 2008; Fonseca *et al.* 2019). This could explain the differences in arthropod consumption by the Andean night monkey in different forest types such as coffee agroecosystems and rural-urban forests (Guzmán *et al.* 2016; Bustamante-Manrique *et al.* 2021) as well as in fragmented forests (Castaño *et al.* 2010; Montilla *et al.* 2021).

In conclusion, this study provides novel information on the variety of arthropods consumed by the Andean night monkey, among which we highlight the orders Coleoptera, Hemiptera and Orthoptera. Our results suggest that perhaps the variety of insects and arachnids this primate

Table 2. Percentage of arthropod fragments (orders and families) found in the scats of a group of Andean night monkeys, *Aotus lemurinus,* in the Bosque de Las Martejas of Pijao, Colombia. *Indicates new records of orders and families for night monkeys.

Order	Percentage of fragments in scats (%)	Family	Percentage of fragments in scats (%)
Araneae	2.1		
		Chrysomelidae*	2.1
		Coccinellidae*	2.1
Coleoptera	43.8	Curculionidae*	8.3
		Elateridae*	10.4
		Staphylinidae*	2.1
Diptera	4.2		
		Cicadellidae	2.1
Hemiptera	10.4	Coreidae*	2.1
		Pentatomidae*	2.1
Hymenoptera	2.1	Formicidae	2.1
Isoptera*	6.3		
Orthoptera	10.4		
Undetermined orders	20.8	Undetermined	66.7
Total	100	Total	100

includes in its diet could be higher if future studies include techniques like DNA metabarcoding that can detect the remains of DNA of soft-bodied organisms such as larvae, spiders, flies and even ectoparasites like acari that are not possible to find in the scat samples. We highlight the importance of insects in the diet of Andean night monkeys, as it is the second most important item in their diet. This raises important questions in the feeding ecology of this species as for example we still do not know how arthropod availability over time and the disturbance of their habitat might influence foraging, or if this primate species has an ecological role in controlling insect populations in the canopy, vital information to understand their role and conservation importance in the ecosystems. Finally, another relevant finding was that by comparing all the information published so far on the consumption of different orders of arthropods by night monkey species, we were able to report the first time the consumption of insects like termites (order Isoptera) by this group of neotropical primates.

Acknowledgements

We thank R. Orozco and the Montilla family for allowing us to conduct the research on their property. Also, to the biology program of the Universidad del Quindío for the provision of the stereoscope and to D. Gaviria for her help in the identification of the arthropods in the preliminary phases of the project. Two anonymous reviewers improved earlier versions of this manuscript.

Literature cited

Arditi, S. I. 1992. Variaciones estacionales en la actividad y dieta de *Aotus azarae* y *Alouatta caraya* en Formosa, Argentina. Boletín Primatológico Latinoamericano 3:11-30.

Bryer, M. A., *et al*. 2015. Macronutrient and energy contributions of insects to the diet of a frugivorous monkey (*Cercopithecus ascanius*). International Journal of Primatology 36:839-854.

Bustamante-Manrique, S., *et al*. 2021. Activity budget, home range and diet of the Colombian night monkey (*Aotus lemurinus*) in peri-urban forest fragments. Primates 62:529-536.

Castaño, J. H., D. C. Ramírez, and J. E. Botero. 2010. Ecología del mono nocturno andino (*Aotus lemurinus*) en fragmentos de bosque subandinos de Colombia. Pp. 69-90 *in* Primatología en Colombia: avances al principio del milenio (Pereira-Bengoa, V., *et al*., eds.). Gráficas San Martín. Bogotá, Colombia.

Defler, T. R. 2010. Historia Natural de los Primates Colombianos. Conservación Internacional Colombia, Universidad Nacional de Colombia. Bogotá, Colombia.

de Souza., *et al*. 2022. Vertical stratification of insect abundance and species richness in an Amazonian tropical forest. Scientific reports 12:1-10.

Felton, A. M., *et al*. 2009. Nutritional goals of wild primates. Functional Ecology 23:70-78.

Fernandez-Duque, E. E., M. Rotundo, and P. Ramirez-Llorens. 2002. Environmental determinants of birth seasonality in night monkeys (*Aotus azarai*) of the Argentinean Chaco. International Journal of Primatology 23:639e656.

Fernandez-Duque, E. 2007. Social monogamy in the only nocturnal haplorhines. Pp. 139-185 *in* Primates in perspective (Campbell, C., ed.). Oxford University Press. New York, U.S.A.

Fernandez-Duque, E., A. Di Fiore, and G. Carrillo-Bilbao. 2008. Behavior, ecology, and demography of *Aotus vociferans* in Yasuní National Park, Ecuador. International Journal of Primatology 29:421-431.

Fonseca, M. L., *et al*. 2019. Influence of arthropod and fruit abundance on the dietary composition of highland Colombian woolly monkeys (*Lagothrix lagotricha lugens*). Folia Primatologica 90:240-257.

Guzmán, A., *et al*. 2016. Agroecosystems and primate conservation: Shade coffee as potential habitat for the conservation of Andean night monkeys in the northern Andes. Agriculture, Ecosystems & Environment 215:57-67.

Grajales-Suaza, E., *et al*. 2021. New record and ecological notes on the Andean night monkey (*Aotus lemurinus* I. Geoffroy, 1846) in a peri-urban area of the municipality of Cartago, Valle del Cauca, Colombia. Neotropical Primates 27:46.

Hladik, C. M., P. Charles-Dominique, and J. J. Petter. 1980. Feeding strategies of five nocturnal prosimians in the dry forest of the west coast of Madagascar. Pp. 41-73 *in* Nocturnal Malagasy primates: ecology, physiology and behavior (Charles-Dominique, P., *et al*., eds.). Academic Press. New York, U.S.A.

Janiak, M. C. 2018. No evidence of copy number variation in acidic mammalian chitinase genes (CHIA) in New World and Old World monkeys. International Journal of Primatology 39:269-284.

Lambert, J. E. 1998. Primate digestion: interactions among anatomy, physiology, and feeding ecology. Evolutionary Anthropology 7:8-20.

Link, A., S. de la Torre, and P. Moscoso. 2021. *Aotus lemurinus*. *In*: IUCN 2021. The IUCN Red List of Threatened Species 2021: e.T1808A17922601. www.iucnredlist.org. Accessed April 30, 2022.

Montilla, S. O., *et al*. 2017. Distribución del mono nocturno andino *Aotus lemurinus* en el departamento del Quindío, Colombia. Mammalogy Notes 4:6-10.

Montilla, S. O., *et al*. 2021. Activity patterns, diet and home range of night monkeys (*Aotus griseimembra* and *Aotus lemurinus*) in Tropical Lowland and Mountain Forests of Central Colombia. International Journal of Primatology 42:130-153.

Pickett, S. B., C. M. Bergey, and A. Di Fiore. 2012. A metagenomic study of primate insect diet diversity. American Journal of Primatology 74:622-631.

Puertas, P., R. Aquino, and F. Encarnación. 1992. Uso de alimentos y competición entre el mono nocturno *Aotus vociferans* y otros mamíferos, Loreto, Perú. Folia Amazónica 4:151-160.

Rothman, J. M., *et al*. 2014. Nutritional contributions of insects to primate diets: implications for primate evolution. Journal of Human Evolution 71:59-69.

Rowe, A. K., *et al*. 2021. Exploratory analysis reveals arthropod consumption in 10 lemur species using DNA metabarcoding. American Journal of Primatology 83:e23256.

Snodgrass, R. E. 1993. Principles of insect morphology. Cornell University Press. New York, U.S.A.

Sutton, S. L., and P. J. Hudson. 1980. The vertical distribution of small flying insects in the lowland rain forest of Zaire. Zoological Journal of the Linnean Society 68:111-123.

Sutton, S. L., C. P. J. Ash, and A. Grundy. 1983. The vertical distribution of flying insects in lowland rain-forests of Panama, Papua New Guinea and Brunei. Zoological Journal of the Linnean Society 78:287-297.

Wolovich, C. K., J. Rivera, and S. Evans. 2010. Insect-foraging in captive owl monkeys (*Aotus nancymaae*). Folia Primatologica 81:63-72.

Wright, P. C. 1985. The costs and benefits of nocturnality for *Aotus trivirgatus* (the night monkey) (ecology, behavior, predation pressure, monogamy, competition). Doctoral dissertation. University of New York. New York, U.S.A.

Wright, P. C. 1986. Ecological correlates of monogamy in *Aotus* and *Callicebus*. Pp. 159-168 *in* Primate Ecology and Conservation: Volume 2 (Else, J. G., and P. C. Lee, eds.). Cambridge University Press. Cambridge, United Kingdom.

Wright, P. C. 1994. The behavior and ecology of the owl monkey. Pp. 97-112 *in Aotus*: The owl monkey (Baer, J. F., R. E. Weller, and I. Kakoma, eds.). Academic Press. New York, U.S.A.

Zeale, M. R., *et al*. 2010. Taxon-specific PCR for DNA barcoding arthropod prey in bat faeces. Molecular Ecology Resources 11:236-244.

Associated editor: Beatríz Bolívar-Cimé
Submitted: June 2, 2022; Reviewed: July 29, 2022.
Accepted: August 12, 2022; Published on line: August 23, 2022.