PREDATION ON TWO BROWN-EARED WOOLLY OPOSSUMS (*CALUROMYS LANATUS*) BY A GROUP OF LARGE-HEADED CAPUCHIN MONKEYS (*SAPAJUS MACROCEPHALUS*) AND NOTES ON THEIR HIERARCHICAL FEEDING BEHAVIOUR

Renato Walter Colan-Rodriguez[1,2], Carolina M. Herrera-Huayhua[1,2], Jackeline Aida Mendoza-Soto[1,3], Criss Quispe-Saenz[1,4], G. Milagros Reyes-Lizarraga[1,5], Luis Antonio Echevarria-Macassi[1,6], Maxime Chauveau[1]

[1]*Crees Foundation For Manu, Fundo Mascoitiana S/N, Madre de Dios, Peru. rcolan@unsa.edu.pe*
[2]*Universidad Nacional de San Agustín de Arequipa, Santa Catalina Nro. 117, Arequipa, Peru*
[3]*Universidad Nacional Agraria La Molina, Av. La Molina S/N, Lima, Peru*
[4]*Universidad Nacional Jorge Basadre Grohmann, Av. Miraflores S/N, Tacna, Peru*
[5]*Universidad Nacional Mayor de San Marcos, Calle German Amezaga Nro. 375, Lima, Peru*
[6]*Universidad Continental, Av. San Carlos Nro. 1980, Huancayo, Peru*

Abstract

The large-headed capuchin monkey (*Sapajus macrocephalus*) is a generalist omnivore known for its dietary flexibility and opportunistic feeding strategies. In September 2022, at the Manu Learning Centre Biological Station in southeast Peru, a group of seven monkeys was observed preying on two brown-eared woolly opossums (*Caluromys lanatus*). The feeding followed a hierarchical order, with the alpha male and a female with an infant feeding first, followed by a juvenile. There was no aggressive behaviour towards juveniles, suggesting adults may facilitate their feeding. This observation adds a new prey item to the capuchin's diet and highlights their diverse dietary habits.

Key words: Diet, opportunistic predation, Neotropical primates, Peruvian Amazon, Manu Biosphere Reserve

Resumen

El mono capuchino de cabeza grande (*Sapajus macrocephalus*) es un omnívoro generalista conocido por su dieta flexible y estrategias de alimentación oportunista. En septiembre del 2022, en la Estación Biológica Manu Learning Centre al sureste de Perú, se observó un grupo de siete monos depredando a dos zarigüeyas lanudas de orejas marrones (*Caluromys lanatus*). La alimentación siguió un orden jerárquico, con el macho alfa y una hembra con un infante alimentándose primero, seguidos por un juvenil. No hubo comportamiento agresivo hacia los juveniles, lo que sugiere que los adultos pueden facilitar su alimentación. Esta observación agrega un nuevo ítem a la dieta de los capuchinos y resalta sus diversos hábitos alimenticios.

Palabras clave: Dieta, depredación oportunista, primates neotropicales, Amazonía peruana, Reserva de Biósfera del Manu

Introduction

The large-headed capuchin monkey (*Sapajus macrocephalus*), sometimes considered a subspecies of *Sapajus apella*, is a platyrrhine primate (2.9-4.6 kg males and 1.3-3.4 kg females) that inhabits almost all types of Amazonian lowland and submontane forests and lives in groups of six to more than 20 individuals, with the number of females exceeding the number of males (Mittermeier et al., 2013; Boubli et al., 2021). It is considered a generalist omnivore since it possesses dietary flexibility, cognitive and manipulative ability, and opportunistic feeding strategies (Mittermeier et al., 2013; Watts, 2020). Capuchin monkey diets can include plant parts, invertebrates, and small vertebrates (Fedigan, 1990; Rose, 1997; Watts, 2020; Boubli et al., 2021; Rylands et al., 2024). Vertebrate prey items include frogs, lizards, birds and their eggs, bats, opossums, rodents, and other monkeys (Izawa, 1978; Ferreira et al., 2002; Resende et al., 2004; Sampaio and Ferrari, 2005; Carretero-Pinzón et al., 2008; Gómez-Posada, 2012; Watts, 2020; Lee and Huang, 2021).

The brown-eared woolly opossum (*Caluromys lanatus*) has a wide distribution and can be found in various habitats, including secondary forests of the Amazon lowland forest (Wilson and Mittermeier, 2015). This nocturnal, solitary, and arboreal species rarely descends to the ground, occupying mainly the canopy and subcanopy, between 5 to 15 m high (Lambert et al., 2005;

Cáceres and Carmignotto, 2006; Vieira and Camargo, 2012; Wilson and Mittermeier, 2015).

Here, we report a predation event by a group of large-headed capuchin monkeys on two brown-eared woolly opossums and provide some comments on the hierarchical feeding behaviour of this monkey species.

Observations

This chance event was observed in the Manu Learning Centre (MLC) Biological Station (12°47'21" S, 71°23'28" W; 460 m.a.s.l.) located in the buffer zone of the Manu National Park in south-east Peru, a 643 ha area of lowland tropical secondary-growth rainforest that has historically experienced different human disturbances at different levels including cattle ranching, agriculture and selective logging (Whitworth et al., 2016). Large-headed capuchin monkey groups are observed at the MLC Biological Station basecamp throughout the year. This is the third record of predation by *Sapajus macrocephalus* on a vertebrate in this area. Previously, Lee and Huang (2021) recorded the predation of the eggs of the russet-backed oropendola (*Psarocolius angustifrons*) and a rodent (*Oecomys* sp.) by a pair of individuals of this species.

On 25th September, 2022 at 14:32, through audio detection, one adult male of *Sapajus macrocephalus* (which henceforth will be called "alpha male") was spotted in an aguaje palm (*Mauritia flexuosa*) at approximately 15 m height, next to the facilities of the MLC basecamp. This individual was eating a juvenile opossum (*Caluromys lanatus*) while at the same time holding a seemingly dead adult opossum by the tail with his left foot. Once the alpha male finished eating the juvenile opossum, he dropped the carcass on the vegetation. Then he proceeded to feed on the adult opossum, starting from the tail, followed by the groin, tearing the stomach fur and skin, and eating some internal organs from the body. None of the other capuchin monkeys that were around attempted to feed on the carcass of the juvenile opossum.

While the alpha male was still eating, a female capuchin with a baby on her back approached and observed the alpha male. A third capuchin, a small juvenile, also came and tried to grab some pieces of internal organs that were hanging from the body (Figure 1). At 14:40, the alpha male left the adult opossum's body on one of the aguaje's branches and at 14:43 the female carrying the infant started to feed on it. At 14:52, this female left the carcass and the small juvenile capuchin took the opossum to eat it in the same aguaje palm. At 14:58, we observed a fourth capuchin, another juvenile, waiting at a distance of 50 cm from the third capuchin who was eating the remains of the opossum carcass.

The fourth capuchin attempted to approach the carcass to feed, but failed because the third capuchin did not let him. Subsequently, the fourth capuchin left to feed on fruits in a Pacay tree (*Inga* sp.). At 15:08, the third capuchin moved with the opossum in its hands to other branches out of sight. The next time we observed the adult opossum's body, at 15:11, it had been re-obtained by the first female, who started to feed on it again. Soon after, the female left the opossum on a branch and moved away. At 15:17, a fifth capuchin, another juvenile, took the adult opossum's body, but was not observed attempting to eat it. It dropped the carcass, which fell onto a termite nest. At 15:39, another juvenile approached the carcass, but did not feed from it. At 15:42 the entire group left the area, with the discarded carcass remaining in the tree on a termite nest. Both opossums were identified first from a distance and then confirmed within close proximity of the carcass, based on a field guide (Emmons and Feer, 1997).

Discussion

We are unsure when exactly the opossums were killed, or what was the cause of death. At the beginning of the observation, the adult opossum appeared to be dead, although it is possible that it was still alive and in a state of

Figure 1. An alpha male *Sapajus macrocephalus* feeding on *Caluromys lanatus*, while a female with a baby on her back observes and a juvenile tries to grab the internal organs. Photograph by Daniel Ash.

thanatosis. Monkeys are commonly reported to kill their prey with craniocervical bites (Steklis and King, 1978; King and Steklis, 1984; Milano and Monteiro-Filho, 2009; Lee and Huang, 2021). According to Steklis and King (1978), the function of the craniocervical bite is the rapid and complete immobilization of the prey, but it could be unnecessary if the predator already has it under control. The fact that the prey is still alive does not always prevent its consumption by the primate. Palmeira and Pianca (2012) observed an adult male black-horned capuchin monkey (*Sapajus nigritus*) eating a brown-eared woolly opossum (*Caluromys lanatus*) that was still alive after being hit by a car.

In total, we recorded a mixed group of seven individuals. There was a hierarchical order when feeding on the adult opossum. First, the alpha male and the female carrying an infant fed, followed by a juvenile. According to di Bitetti and Janson (2001), the alpha male and alpha female, who tend to occupy central-forward positions of a foraging group, are able to monopolize newly discovered food sources and thus obtain a major share of them, even when the food was found by other individuals.

In large-headed capuchin monkeys hierarchical feeding behaviour can be due to different causes: dominance through physical superiority (size, strength, and agility) or avoidance of aggression which can be achieved by maintaining close kinship or alliance with dominants (Janson, 1985; Kurland, 1977). These strategies may have happened in our observation, given that only one juvenile ate the adult opossum after the alpha male and female had finished, and two more were nearby but did not interact with the carcass and one transported it without eating it.

We did not observe aggressive behaviour by adults towards juveniles when they tried to grab pieces of the opossum. Tolerance towards juveniles during feeding has been previously recorded in *Sapajus* and *Cebus* (Izawa, 1980; Perry and Rose, 1994; Coelho et al., 2015), and could be related to the lack of skill in the management and acquisition of food by juveniles, as occurs in other primate species when they are choosing leaves and soft fruits rather than hard ones (Janson and van Schaik, 1993; Riveros and Ferreira, 2001). In our observations, the adults may have been facilitating the consumption of the opossum for the juveniles, since the adults fed first and left the carcass, when it was already open and internal organs and tissues were easily accessible. This facilitation could be a third cause for the observed order of feeding during the predation event.

According to Watts (2020), the main reason why primates may feed on vertebrates may be to supplement their diet with micronutrients that are scarce in plant material, rather than for protein consumption. In terms of seasonality, events of vertebrate predation have been reported in *Sapajus* in both dry and wet seasons with the same frequency (Ferreira et al., 2002; Palmeira and Pianca, 2012; Watts, 2020; Lee and Huang, 2021), but the small sample size for this type of event limits the ability to draw conclusions about seasonality. The foraging behaviour of capuchin monkeys is flexible and exploratory, adjusting their feeding based on resource availability (Sabbatini et al., 2008).

Our observation adds a novel prey item to the known diet of large-headed capuchin monkeys and reinforces their opportunistic and diverse dietary behaviour. This observation also provides an example of hierarchical order in feeding behaviour in this primate species.

Acknowledgments

The authors would like to express their sincere gratitude to Quinn Meyer, owner and Juan Carlos Cárdenas, General Manager of Crees Manu and their team for giving us the opportunity to study the biodiversity of regenerating forests inside the Manu Learning Centre Biological Field Station. We are grateful to Edgar Marquina and Joseph L. Oakley, for reviewing the manuscript and constantly encouraging us to share educational and scientific material, and Daniel Ash for providing us with photographs of the observation. Finally, we thank M. Bowler for advising us on the updated taxonomy.

References

Boubli, J. P., Stevenson, P. R., Palacios, E., de la Torre, S., Ravetta, A. L., Messias, M. R., Carvalho, A. S. and Mittermeier, R. A. 2021. *Sapajus apella*. The IUCN Red List of Threatened Species 2021: e.T172351505A192594550. Accessed on 1 February 2023. https://www.iucnredlist.org/species/172351505/192594550

Cáceres, N. C. and Carmignotto, A. P. 2006. *Caluromys lanatus*. *Mamm. Species* 803: 1–6. https://doi.org/10.1644/803.1

Carretero-Pinzón, X., Defler, T. R. and Ferrari, S. F. 2008. Observation of black-capped capuchins (*Cebus apella*) feeding on an owl monkey (*Aotus brumbacki*) in the Colombian Llanos. *Neotrop. Primates* 15: 62–63. https://doi.org/10.1896/044.015.0210

Coelho, C. G., Falótico, T., Izar, P., Mannu, M., Resende, B. D., Siqueira, J. O. and Ottoni, E. B. 2015. Social learning strategies for nut-cracking by tufted capuchin monkeys (*Sapajus* spp.). *Anim. Cogn.* 18: 911–919. https://doi.org/10.1007/s10071-015-0861-5

di Bitetti, M. S. and Janson, C. H. 2001. Social foraging and the finder's share in capuchin monkeys, *Cebus apella*. *Anim. Behav.* 62: 47–56. https://doi.org/10.1006/anbe.2000.1730

Emmons, L. H. and Feer, F. 1997. *Neotropical rainforest mammals: A field guide*. The University of Chicago Press, Chicago.

Fedigan, L. M. 1990. Vertebrate predation in *Cebus capucinus*: meat eating in a neotropical monkey. *Folia Primatol.* 54: 196–205. https://doi.org/10.1159/000156444

Ferreira, R., Resende, B. D., Mannu, M., Ottoni, E., B. and Izar, P. 2002. Bird predation and prey-transfer in brown capuchin monkeys (*Cebus apella*). *Neotrop. Primates* 10: 84–89. https://doi.org/10.62015/np.2002.v10.510

Gómez-Posada, C. 2012. Dieta y comportamiento alimentario de un grupo de mico maicero *Cebus apella* de acuerdo a la variación en la oferta de frutos y artrópodos, en la Amazonía colombiana. *Acta Amaz.* 42: 363–372. https://doi.org/10.1590/S0044-59672012000300008

Izawa, K. 1978. Frog-eating behavior of wild black-capped capuchin (*Cebus apella*). *Primates* 19: 633–642. https://doi.org/10.1007/BF02373631

Izawa, K. 1980. Social behavior of the wild black-capped capuchin (*Cebus apella*). *Primates* 21: 443–467. https://doi.org/10.1007/BF02373834

Janson, C. 1985. Aggressive competition and individual food consumption in wild brown capuchin monkeys (*Cebus apella*). *Behav. Ecol. Sociobiol.* 18: 125–138.

Janson C. and van Schaik C. 1993. Ecological risk aversion in juvenile primates: slow and steady wins the race. In: *Juvenile primates: Life history, development, and behavior*, M. E. Pereira and L. A. Fairbanks (eds). Oxford University Press, Oxford.

King, G. E. and Steklis, H. D. 1984. New evidence for the craniocervical killing bite in primates. *J. Hum. Evol.* 13: 469–481. https://doi.org/10.1016/S0047-2484(84)80001-9

Kurland, J. A. 1977. *Contributions to primatology. Volume 12: Kin Selection in the Japanese Monkey*. Karger, Basel.

Lambert, T. D., Malcolm, J. R. and Zimmerman, B. L. 2005. Variation in small mammal species richness by trap height and trap type in southeastern Amazonia. *J. Mammal.* 86: 982–990. https://doi.org/10.1644/1545-1542(2005)86[982:VISMSR]2.0.CO;2

Lee, A. and Huang, M. 2021. Oropendola nest predation and rodent consumption by the black-capped capuchin (*Sapajus apella*) in the Manu Biosphere Reserve, Peru. *Neotrop. Primates* 27: 30–32. https://doi.org/10.62015/np.2021.v27.63

Milano, M. Z. and Monteiro-Filho, E. L. A. 2009. Predation on small mammals by capuchin monkeys, *Cebus cay*. *Neotrop. Primates* 16: 78–80. https://doi.org/10.1896/044.016.0210

Mittermeier, R. A., Rylands, A. B. and Wilson, D. E. 2013. *Handbook of the mammals of the world. Volume 3: Primates*. Lynx Edicions, Barcelona.

Palmeira, F. B. L. and Pianca, C. C. 2012. Predation attempt on a roadkilled brown-eared woolly opossum (*Caluromys lanatus*) by a black-horned capuchin (*Sapajus nigritus*). *Neotrop. Primates* 19: 36–38. https://doi.org/10.1896/044.019.0107

Perry, S. and Rose, L. 1994. Begging and transfer for coati meat by white-faced capuchin monkeys, *Cebus capucinus*. *Primates* 35: 409–415. https://doi.org/10.1007/BF02381950

Resende, B., Greco, V., Ottoni, E. and Izar, P. 2004. Some observations on the predation of small mammals by tufted capuchin monkeys (*Cebus apella*). *Neotrop. Primates* 11: 709–716. https://doi.org/10.62015/np.2003.v11.543

Riveros, M. and Ferreira, C. 2001. Comportamiento alimentario de una tropa de *Pithecia pithecia* (mono viudo cara blanca), en una isla del embalse de Guri, estado Bolívar. *Ecotropicos* 14: 57–64.

Rose, L. M. 1997. Vertebrate predation and food-sharing in *Cebus* and *Pan*. *Int. J. Primatol.* 18: 727–765. https://doi.org/10.1023/A:1026343812980

Rylands, A. B., Mittermeier, R. A., Lynch, J. W., Jerusalinsky, L., Strier, K. B., Cortés-Ortiz, L., Link, A., de la Torre, S., de Melo, F. R., Canale, G. R., Boubli, J. P., Cornejo, F. M. and Sechrest, W. 2024. *Neotropical primates*. Lynx Illustrated Checklists. Lynx Nature Books in association with Re:wild. https://www.lynxeds.com/product/neotropical-primates/

Sabbatini, G., Stammati, M., Tavares, M. and Visalberghi, E. 2008. Behavioral flexibility of a group of bearded capuchin monkeys (*Cebus libidinosus*) in the National Park of Brasília (Brazil): Consequences of cohabitation with visitors. *Braz. J. Biol.* 68: 685–693. https://doi.org/10.1590/S1519-69842008000400002

Sampaio, D. T. and Ferrari, S. F. 2005. Predation of an infant titi monkey (*Callicebus moloch*) by a Tufted Capuchin (*Cebus apella*). *Folia Primatol.* 76: 113–115. https://doi.org/10.1159/000083617

Steklis, H. D. and King, G. N. 1978. The craniocervical killing bite: toward an ethology of primate predatory behavior. *J. Hum. Evol.* 7: 567–581. https://doi.org/10.1016/S0047-2484(78)80043-8

Vieira, E. and Camargo, N. 2012. Uso do espaço vertical por marsupiais brasileiros. In: *Os marsupiais do Brasil: biologia, ecologia e evolução*, N. Cáceres and F. E. Monteiro (eds.), pp.347–364. UFMS, Brasília.

Watts, D. P. 2020. Meat eating by nonhuman primates: A review and synthesis. *J. Hum. Evol.* 149: 102882. https://doi.org/10.1016/j.jhevol.2020.102882

Whitworth, A., Downie, R., von May, R., Villacampa, J. and MacLeod, R. 2016. How much potential biodiversity and conservation value can a regenerating rainforest provide? A 'best-case scenario' approach from the Peruvian Amazon. *Trop. Conserv. Sci.* 9: 224–245. https://doi.org/10.1177/194008291600900112

Wilson, D. E. and Mittermeier, R. A. 2015. *Handbook of the mammals of the world. Volume 5: Monotremes and marsupials*. Lynx Edicions, Barcelona.