ACTA
AMAZONICA | http://dx.doi.org/10.1590/1809-4392202501061

BIODIVERSITY AND CONSERVATION | SHORT COMMUNICATION

Multispecies aggregations of bats at kitchen waste pools in western Amazonia: a new source of mineral licks?

William Ernest MAGNUSSON[1,2], Paulo Estefano Dineli BOBROWIEC[2,3*], João Araújo DE SOUZA[1]

[1] Instituto Nacional de Pesquisas da Amazônia, Coordenação de Biodiversidade, Manaus, Amazonas, Brazil

[2] Instituto Nacional de Pesquisas da Amazônia, Programa de Pós-Graduação em Ecologia, Manaus, Amazonas, Brazil

[3] Instituto Tecnológico Vale (ITV), Belém, Pará, Brazil

* Corresponding author: paulobobro@gmail.com

ABSTRACT

We recorded aggregations of frugivorous bats swooping down to drink from pools formed by kitchen drains in two locations in western Amazonia. Videos and photographs show at least two species and three genera of phyllostomid bats with this behavior. While not possible to count all the individual bats, at least 27 individuals (mainly smaller species) visited one pool in a 6 second interval and at least 17 individuals (mainly larger) visited a nearby pool in a 5 second interval. This behaviour is similar to mammals and birds that aggregate at mineral-rich sites in western Amazonia (and elsewhere in the world) and the bats were probably seeking mineral salts in the drain water. The phenomenon facilitates close observation of bats, but this behavior raises the possibility of transmission of pathogens associated with humans or their domestic animals to bats and requires future investigations.

KEYWORDS: Chiroptera, Phyllostomidae, salt, behaviour

Agregações multiespécies de morcegos em poças de resíduos de cozinha na Amazônia ocidental: uma nova fonte de minerais para lamber?

RESUMO

Registramos agregações de morcegos frugívoros descendo para beber em poças formadas por ralos de cozinha em dois locais no oeste da Amazônia. Vídeos e fotografias mostram pelo menos duas espécies e três gêneros de morcegos filostomídeos com esse comportamento. Embora não seja possível contar todos os morcegos individualmente, pelo menos 27 indivíduos (principalmente espécies menores) visitaram uma poça em um intervalo de 6 segundos e pelo menos 17 indivíduos (principalmente maiores) visitaram uma poça próxima em um intervalo de 5 segundos. Esse comportamento é semelhante ao de mamíferos e aves que se agregam em locais ricos em minerais no oeste da Amazônia (e em outras partes do mundo) e os morcegos provavelmente buscavam sais minerais na água do esgoto. O fenômeno facilita a observação atenta dos morcegos, mas esse comportamento levanta a possibilidade de transmissão de patógenos associados aos humanos ou seus animais domésticos para os morcegos e requer investigações futuras.

PALAVRAS-CHAVE: Chiroptera, Phyllostomidae, sal, comportamento

Multispecies aggregations of bats at concentrated food sources, such as fruiting trees, are common (Galindo-González *et al*. 2000). However, when obtaining water, bats generally drink more individually from relatively large bodies of water (Tuttle 2007; Torrent *et al*. 2018). Western Amazônia is humid and aggregations of mammals and birds have been reported at sites that are rich in minerals, *i.e.*, mineral licks (the behavior is called geophagy; Santorelli and Magnusson 2024). Mineral licks are natural places where wild animals gather to supplement their diets with essential minerals, such as sodium, calcium, iron, and magnesium, that are often lacking in their regular diet (Mahaney and Krishnamani 2003; Voigt *et al*. 2008). For instance, frugivorous bats often do not get enough sodium in their usual diet (Voigt *et al*. 2008; Ghanem *et al*. 2013). Sodium is particularly important for pregnant or lactating females, who have elevated nutritional needs (Bravo *et al*. 2008; Ghanem *et al*. 2013). Another source of essential minerals may be provided by kitchen wastes when wastewater accumulates in puddles. Because people add salt during cooking, and they wash iron pots and pans, waste water may accumulate a variety of minerals important to animals. These puddles may contain a variety of elements such as sodium, potassium, calcium, magnesium, phosphorus, iron, and trace metals, such as zinc, copper, and

CITE AS: Magnusson, W.E.; Bobrowiec, P.E.D.; De Souza, J.A. 2025. Multispecies aggregations of bats at kitchen waste pools in western Amazonia: a new source of mineral licks? *Acta Amazonica* 55: e55bc25106.

manganese, originating from food residues and detergents. Small amounts of silicon, chlorine, or sulfur compounds may also be present, offering a potentially rich and diverse source of micronutrients. Use of these artificial puddles, as reported in studies of swimming pools used for drinking and foraging (McGee *et al*. 2023), suggests that such behaviour in bats may be more common than previously recognized. Here, we describe the diversity of bat species that visit kitchen ponds in rural villages of central Amazonia.

We observed and noted multispecies aggregations of bats at two locations in western Amazonia. At one (4°58'30" W, 61°33'36" S), bats congregated at a pool formed by kitchen effluent from a restaurant (Pousada Terra Rica, km 300), on BR-319 highway, approximately 270 km from the city of Manaus. The site does not experience seasonal flooding, allowing puddles to remain permanent, and the bats were observed between January and June 2023. Bats appeared unaffected by illumination from surrounding buildings. At the second (7°00'00" W, 60°39'36" S), in a village on the banks of the Aripuanã River, the bats congregated in two shallow (< 10 cm depth) pools formed by effluent from the kitchen of a house. One pool was at the base of the wooden stilts supporting the house and the other was about 5m distant. This site is subject to several months of inundation during the high-water season, when the residents move to higher ground. Our observations were made during April 2005 and March 2024 during the low-water season and the puddles were present.

We filmed the bats using a Sony FDR-AX53 video camera illuminated by a Ledlenser H7r headlamp, and photographed some individuals with an OM SYSTEM TG7 camera. We filmed between 19:30 and 21:00 h at the two pools on two consecutive nights in a village on the Aripuanã River in 2024. The bats at the first pool at the base of the stilts supporting the house were filmed from about 1.5 m from the long-axis of the water, and from the end of the pool at the point that the bats were exiting. The bats appeared to ignore the photographer, repeatedly circling under the house to access the pool and frequently brushing the photographer as they passed. Bats at the second pool were filmed from a distance of about 3 m.

Bats of a variety of sizes were seen at the first location. We tried to estimate the number of bats at the second location, but the bats flew around so quickly that we were unable to count them. Using video during an interval that we assumed was short enough to include only one sighting per individual, we counted 27 individuals in 6 seconds. At the second pond, we counted 17 individuals in 5 seconds. We think it possible that hundreds of individuals visited the ponds.

All individuals filmed or photographed (Figure 1) had well-developed nose leaves typical of species in the family Phyllostomidae. Identification of species usually requires capture but one of us (P.E.D.B.) has extensive experience in the identification of Amazonian bats, and based on videos (https://youtu.be/2D-MLx7G7MA) and photographs, at least two species (*Artibeus literatus*, *A. obscurus*) and the genera

Figure 1. This photograph shows a bat, likely a *Uroderma bilobatum*, flying low over a kitchen puddle, extending its mouth to drink from the water's surface.

Uroderma, *Vampyriscus* or *Platyrrhinus*, were likely to be visiting the pools. The following species are known to occur in this area: *U. bilobatum* Peters, 1866, *V. bidens* (Dobson, 1878), *P. brachycephalus* (Rouk and Carter, 1972), and *P. incarum* (Thomas, 1912) (Bobrowiec 2012).

Bats aggregating at these water sources appears to resemble similar aggregations of mammals and birds at salt-licks elsewhere (Brightsmith and Cáceres 2017) and we suggest that the bats were seeking salts in the drain water. While we were unable to identify most of the bats in the videos, the wide range of sizes and behaviors suggests that the aggregations included many of the frugivorous bats from this region (Bobrowiec 2012). Some frugivorous bats may benefit from the food sources in villages, including papaya, guava, mango, banana, and wax jambu. The area occupied by villages and the BR-319 highway are relatively small (< 10 ha) and surrounded by vast tracts of preserved forest, providing these bats with the opportunity to forage in disturbed areas. Artificial mineral deposits can serve as an additional attractant for frugivorous bats in altered areas surrounded by preserved forests in the Amazon. Both locations exhibit low soil fertility (BR-310 ~ 0.138 $cmol^{+}\ kg^{-1}$, Aripuanã River ~ 0.209 $cmol^{+}\ kg^{-1}$; Zuquim *et al*. 2019), a condition of extensive areas in central Amazonia dominated by podzolic soils or highly leached oxisols (Quesada *et al*. 2011). In the Amazon, plant productivity is closely linked to soil nutrient availability (Quesada *et al*. 2012), which may help explain why bats were observed drinking from kitchen puddles, an alternative source of mineral salts that are otherwise scarce in their primarily frugivorous diets. Another piece of evidence that suggests that frugivorous bats may be gaining nutritional value from the pools is that all observed species were frugivorous, while vampire and carnivorous or insectivorous bats were absent. The vampire bat *Desmodus rotundus* (É. Geoffroy, 1810), for example, is also common in riverside villages (Bobrowiec *et al*. 2015), but was not observed in the footage. It is possible that blood intake ensures adequate minerals for vampire bats.

However, even if the bats benefit from salts in the kitchen effluence, the association of bats with humans raises the possibility of transmission of pathogens associated with humans or their domestic livestock to bats (known as spillback, reverse transmission from humans to animals - e.g., transmission of SARS-CoV-2 from humans into bats; Sparrer *et al*. 2023) and this would be a useful focus for future studies (Salvarani *et al*. 2025). However, spillover events have been more widely investigated (Sparrer *et al*. 2023). Disturbed areas such as riparian communities may increase zoonotic spillover events (Ellwanger *et al*. 2022). Bats are known to be carriers of the rabies virus and potential hosts of the COVID-19, Ebola (Africa), and Nipah (Australasia and Malaysia) viruses, all of which have the capacity to spillover to humans (Ellwanger *et al*. 2022). Contact between bats and humans may occur accidentally, either through bats entering households, facilitated by the proximity of water puddles to homes, or through domestic cats that may occasionally hunt bats near the puddles and bring them close to people. Although drinking domestic effluent may increase only slightly the potential for transmission of diseases from humans to bats, it greatly increases the chance that bats will be exposed to diseases associated with humans and their domestic animals. To reduce the risk of contact between humans and bats that visit puddles, we recommend the construction of small pits covered with wooden boards, connected to kitchen sink by pipes. This measure aims to prevent the formation of puddles and, consequently, to discourage the aggregation of bats in these areas, given the lack of wastewater management in the villages.

In conclusion, we described here a remarkable aggregation of frugivorous Amazonian bats at small water pools of drainage from kitchen sinks, which we propose is associated with mineral salts. The diversity of species and abundance of individuals observed over a short period suggest that such sites may serve as important nutritional supplementation points for bats, especially in modified areas still surrounded by extensive preserved forest. However, the association with human effluents also raises concerns regarding transmission of pathogens, especially from humans and domestic animals to bats, highlighting the need for future studies on the potential risks of pathogen transmission among bats, humans, and domestic animals.

REFERENCES

Bobrowiec, P.E.D. 2012. A Chiroptera preliminary survey in the middle Madeira River region of Central Amazonia, Brazil. *Mammalia* 76: 277-283.

Bobrowiec, P.E.D.; Lemes, M.R.; Gribel, R. 2015. Prey preference of the common vampire bat (*Desmodus rotundus*, Chiroptera) using molecular analysis. *Journal of Mammalogy* 96: 54-63.

Bravo, A.; Harms, K.E.; Stevens, R.D.; Emmons, L.H. 2008. Collpas: activity hotspots for frugivorous bats (Phyllostomidae) in the Peruvian Amazon. *Biotropica* 40: 203-210.

Brightsmith, D.J.; Cáceres, A. 2017. Parrots consume sodium-rich palms in the sodium deprived landscape of the western Amazon Basin. *Biotropica* 49: 921-931.

Ellwanger, J.H.; Fearnside, P.M.; Ziliotto, M.; Valverde-Villegas, J.M.; Veiga, A.B.G.; Vieira, G.F.; *et al.* 2022. Synthesizing the connections between environmental disturbances and zoonotic spillover. *Anais da Academia Brasileira de Ciências* 94: e20211530.

Ghanem, S.J.; Ruppert, H.; Kunz, T.H.; Voigt, C.C. 2013. Frugivorous bats drink nutrient-and clay-enriched water in the Amazon rain forest: support for a dual function of mineral-lick visits. *Journal of Tropical Ecology* 29: 1-10.

Mahaney, W.C.; Krishnamani, R. 2003. Understanding geophagy in animals: standard procedures for sampling soils. *Journal of Chemical Ecology* 29: 1503-1523.

McGee, J.E.; Bennett, V.J.; Maartens, S.J. 2023. The use of swimming pools by bats on a game reserve in South Africa. *The Journal of Wildlife Management* 87: e22479.

Quesada, C.A.; Lloyd, J.; Anderson, L.O.; Fyllas, N.M.; Schwarz, M.; Czimczik, C.I. 2011. Soils of Amazonia with particular reference to the RAINFOR sites. *Biogeosciences* 8: 1415-1440.

Quesada, C.A.; Phillips, O.L.; Schwarz, M.; Czimczik, C.I.; Baker, T.R.; Patiño, S.; *et al*. 2012. Basin-wide variations in Amazon forest structure and function are mediated by both soils and climate. *Biogeosciences* 9: 2203-2246.

Salvarani, F.M.; Oliveira, H.G.S.; Correa, L.Y.S.; Soares, A.A.L.; Ferreira, B.C. 2025. The importance of studying infectious and parasitic diseases of wild animals in the Amazon Biome with a focus on One Health. *Veterinary Sciences* 12: 1-19.

Santorelli, S.; Magnusson, W.E. 2024. Sodium hunger in the Amazon. *International Journal of Zoology and Animal Behaviour* 7: 000561.

Sparrer, M.N.; Hodges, N.F.; Sherman, T.; VandeWoude, S.; Bosco-Lauth, A.M.; Mayo, C.E. 2023. Role of spillover and spillback in SARS-CoV-2 transmission and the importance of one health in understanding the dynamics of the COVID-19 pandemic. *Journal of Clinical Microbiology* 61: e01610-22.

Torrent, L.; López-Baucells, A.; Rocha, R.; Bobrowiec, P.E.D.; Meyer, C.F.J. 2018. The importance of lakes for bat conservation in Amazonian rainforests: an assessment using autonomous recorders. *Remote Sensing in Ecology and Conservation* 4: 339-351.

Tuttle, M.D. 2007. Drinking on the fly. *National Wildlife* 45: 26-31.

Voigt, C.C.; Capps, K.A.; Dechmann, D.K.; Michener, R.H.; Kunz, T.H. 2008. Nutrition or detoxification: why bats visit mineral licks of the Amazonian rainforest. *PLoS ONE* 3: e2011.

Zuquim, G.; Stropp, J.; Moulatlet, G.M.; Van Doninck, J.; Quesada, C.A.; Figueiredo, F.O.; *et al*. 2019. Making the most of scarce data: Mapping soil gradients in data-poor areas using species occurrence records. *Methods in Ecology and Evolution* 10: 788-801.

RECEIVED: 30/04/2025
ACCEPTED: 20/06/2025
ASSOCIATE EDITOR: Sergio Borges
DATA AVAILABILITY : The data that support the findings of this study were published in this article.
AUTHOR CONTRIBUTIONS:
MAGNUSSON, W.E.: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Resources, Supervision, Visualization, Writing - original draft, Writing - review & editing.
BOBROWIEC, P.E.D.: Funding acquisition, Investigation, Visualization, Writing - original draft, Writing - review & editing.
De SOUZA, J.A.: Investigation.