

**FIRST PHOTOGRAPHIC
RECORD OF PREDATION
ON A BLUE-BANDED
MORPHO (MORPHO SP.) BY
THE EASTERN PYGMY
MARMOSET (CEBUELLA
NIVEIVENTRIS) IN
SOUTHWESTERN
AMAZONIA**

**PRIMEIRO REGISTRO FOTOGRÁFICO DE PREDACÃO DE UMA
BORBOLETA-MORFO DE FAIXA AZUL (MORPHO SP.) PELO SAGUI-
PIGMEU-ORIENTAL (CEBUELLA NIVEIVENTRIS) NO SUDOESTE DA
AMAZÔNIA**

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ABSTRACT

The eastern pygmy marmoset, *Cebuella niveiventris*, is an Amazonian callitrichid whose diet is centered on plant exudates and supplemented opportunistically by arthropods, fruits, and flowers. However, arthropod prey are rarely identified beyond broad categories in field studies. We report a photographic record of predation on a blue-banded *Morpho* butterfly by a free-ranging *C. niveiventris* in an urban forest fragment at the Federal University of Acre, Rio Branco, southwestern Brazilian Amazonia. On 13 November 2017, one individual was photographed feeding on a butterfly while clinging vertically to a tree trunk. The marmoset consumed the body and part of the wings. Visible dorsal and ventral wing patterns support assignment to *Morpho* sp., although species-level identification was not possible. This record expands the documented trophic repertoire of *C. niveiventris* and highlights the value of photographic evidence for brief feeding events in small callitrichids.

Keywords: Callitrichidae; feeding behavior; insectivory; Lepidoptera; natural history; urban forest fragment.

RESUMO

O sagui-pigmeu-oriental, *Cebuella niveiventris*, é um calitriquídeo amazônico cuja dieta é centrada em exsudatos vegetais e complementada oportunisticamente por artrópodes, frutos e flores. No entanto, presas artrópodes raramente são identificadas além de categorias taxonômicas amplas em estudos de campo. Relatamos um registro fotográfico de predação de uma borboleta *Morpho* de faixa azul por um indivíduo livre de *C. niveiventris* em um fragmento florestal urbano da Universidade Federal do Acre, Rio Branco, sudoeste da Amazônia brasileira. Em 13 de novembro de 2017, um indivíduo foi fotografado alimentando-se de uma borboleta

enquanto permanecia verticalmente preso ao tronco de uma árvore. O sagui consumiu o corpo e parte das asas. Os padrões dorsais e ventrais visíveis sustentam a identificação como *Morpho* sp., embora a identificação específica não tenha sido possível. O registro amplia o repertório trófico documentado de *C. niveiventris* e destaca o valor de evidências fotográficas para eventos breves de alimentação.

Palavras-chave: comportamento alimentar; Callitrichidae; história natural; insetivoria; Lepidoptera; fragmento florestal urbano.

1. INTRODUCTION

The eastern pygmy marmoset, *Cebuella niveiventris*, is one of the smallest anthropoid primates in Amazonia. It is a diminutive callitrichid characterized by predominantly yellowish-gray dorsal pelage, a distinctly whitish ventrum, and a black-banded tail (Porter et al. 2023; Messias et al. 2011). Under the current taxonomic arrangement, populations occurring south of the Solimões-Amazonas/Napo system, including those from Acre, Brazil, are assigned to *C. niveiventris* (Garbino et al. 2019).

Like other pygmy marmosets, this species depends heavily on plant exudates, which constitute the core of its diet, whereas fruits, flowers, and arthropods are consumed opportunistically (Rylands and Mittermeier 2013; Ramirez et al. 1977; Soini 1982; Townsend 2001; Yépez et al. 2005). Because exudate-producing trees play a central role in its feeding ecology, variation in the local availability of these resources can strongly influence habitat use, activity patterns, and foraging behavior.

Arthropod consumption by *Cebuella* is well established, and insects are recognized as an important opportunistic component of the diet

in addition to plant exudates, fruits, and flowers (Ramirez et al. 1977; Soini 1982; Townsend 2001; Rylands and Mittermeier 2013; Yépez et al. 2005). However, prey items are rarely identified beyond broad taxonomic categories in field studies because feeding events are often brief, occur in complex forest strata, and are difficult to observe in sufficient detail. As a result, the diversity of arthropods exploited by pygmy marmosets remains incompletely documented.

This gap is relevant because animal prey may contribute disproportionately to protein, lipid, and micronutrient intake, even when consumed less frequently than plant exudates (Rothman et al. 2014). In small-bodied primates with high energetic demands, occasional prey capture can represent an important complementary resource, particularly in environments where prey availability varies seasonally or locally. Therefore, documenting the identity of arthropod prey, even from isolated observations, contributes to a more realistic understanding of feeding flexibility and opportunistic foraging in pygmy marmosets.

This limitation is especially important in natural history studies conducted in human-modified environments, where altered habitat structure, edge effects, and frequent human presence may influence both prey availability and foraging opportunities. Urban forest fragments may differ from continuous forests in canopy structure, light incidence, edge density, and the abundance of certain insects, including large diurnal butterflies that use open or semi-open areas. At the same time, these fragments often allow repeated observation of resident primate groups, increasing the probability of recording short-lived behaviors that would otherwise remain undocumented.

In this context, opportunistic photographic records can provide valuable natural history information on prey selection in this genus, particularly when diagnostic external characters of the prey are visible and permit more precise identification. Photographs are especially useful for feeding events involving arthropods because they allow later inspection of characters such as body size, wing shape, color pattern, and visible dorsal or ventral markings. Even when species-level identification is not possible, photographic documentation may allow prey assignment to a more informative taxonomic level than direct observation alone.

Here, we present the first photographic record of predation on a blue-banded *Morpho* butterfly (*Morpho* sp.) by a free-ranging *Cebuella niveiventris* in southwestern Brazilian Amazonia.

2. METHODOLOGY

This record was obtained during an ongoing field study on the behavioral ecology and diet of *Cebuella niveiventris* conducted in the Zoobotanical Park of the Federal University of Acre (UFAC), Rio Branco, Acre, Brazil. The study area is an approximately 150-ha urban forest fragment on the UFAC campus, composed predominantly of open ombrophilous forest. Field monitoring extended from August 2017 to February 2019 and comprised 28 sampling days. The predation event described here was recorded on 13 November 2017 in a sunlit section of the main trail of the Zoobotanical Park, in an area subject to frequent pedestrian traffic (approximate observation area: 9°57'20.1"S, 67°52'17.3"W; Figure 1).

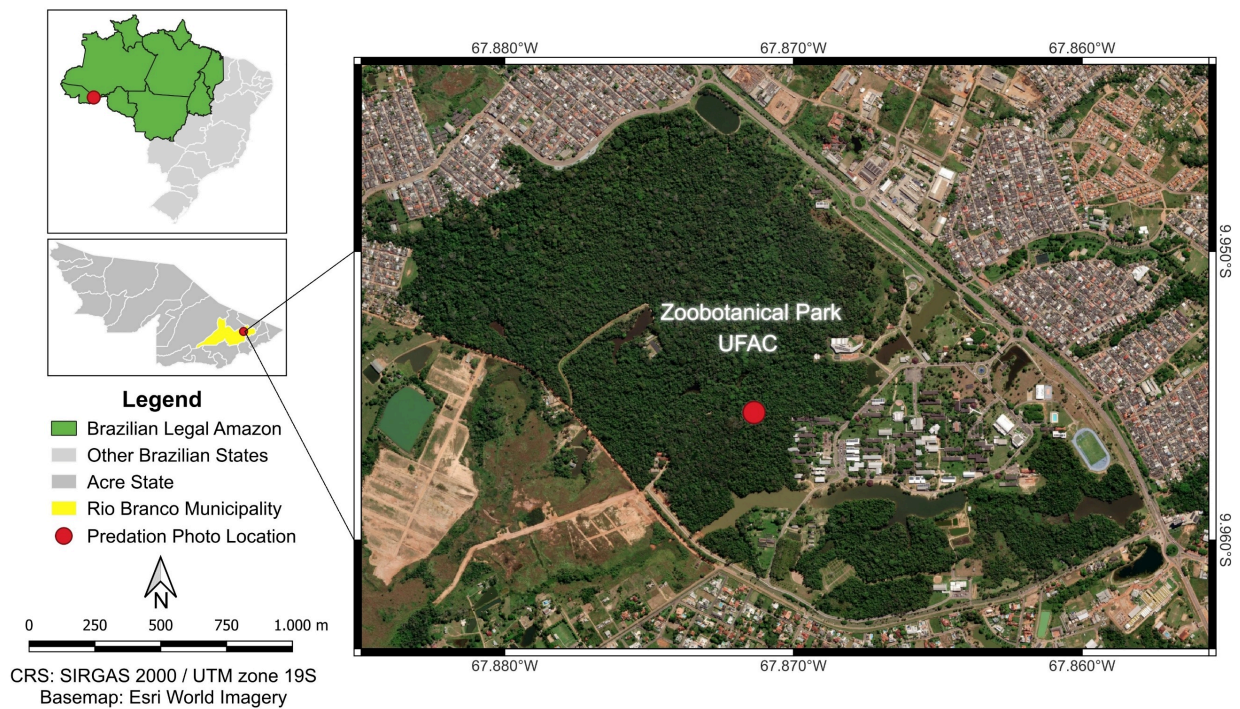


Figure 1: Location of the predation photo point in the Zoobotanical Park of the Federal University of Acre (UFAC), Rio Branco, Acre, Brazil. Insets show the position of Acre within Brazil and Rio Branco within Acre. The red symbol marks the approximate location where predation on *Morpho* sp. by *Cebuella niveiventris* was photographed. Coordinate reference system: SIRGAS 2000 / UTM zone 19S. Basemap: Esri World Imagery.

Behavioral observations were conducted using scan sampling at 15-min intervals (Altmann 1974). Across the study period, a total of 1,308 scan records were obtained. Daily observation sessions ranged from approximately 7 h 45 min to 12 h 45 min, generally spanning the period from early morning to late afternoon. Throughout the monitoring period, the focal group varied from four to six individuals, with five individuals recorded in most sampling sessions.

Behavioral data were systematically recorded on standardized field sheets using predefined categories, including feeding, resting, locomotion, allogrooming, and vocalizing. Whenever possible, additional notes were taken on the type of food item consumed, the substrate used, and the immediate context of the observed behavior. Because *Cebuella niveiventris* is predominantly exudativorous, with plant exudates forming the core of its diet (Ramirez et al. 1977; Soini 1982), special attention was given to trees

used for gouging and exudate feeding. Trees regularly exploited by the group were marked with individual codes, georeferenced, and identified to genus or species whenever possible.

In addition to scan sampling, photographic records were obtained regularly during fieldwork to document feeding events, social interactions, locomotor behavior, interspecific encounters, and other relevant aspects of the group's natural history. These photographs served as complementary observational records and, when possible, assisted in the identification of food items or interacting organisms. The event reported here was photographed with a 16-megapixel Canon PowerShot SX520 HS digital camera.

Prey identification was based on external characters visible in the photographic sequence, including wing shape, the presence of a conspicuous blue dorsal band, and the pattern visible on the ventral wing surface. The images were inspected conservatively, and the prey was assigned only to the lowest taxonomic level supported by the available visual evidence. Because the photographs did not provide all diagnostic characters needed to distinguish among closely similar blue-banded *Morpho* species, we avoided species-level assignment and retained the identification as *Morpho* sp.

This report is based exclusively on noninvasive field observation and photographic documentation of free-ranging animals. No animal was captured, handled, marked, or experimentally manipulated.

3. RESULTS AND DISCUSSION

During routine observations, one individual of *Cebuella niveiventris* was observed feeding on a butterfly while clinging vertically to a tree trunk in a sunlit section of the main trail of the Zoobotanical Park.

The event occurred in an accessible portion of the fragment with frequent pedestrian traffic.

The marmoset remained attached to the vertical trunk while manipulating the prey close to its mouth, using the trunk as a support surface during feeding. This posture is consistent with the scansorial and trunk-clinging behavior commonly associated with exudate foraging in pygmy marmosets, but in this case the same positional behavior was used during handling and consumption of animal prey. The observation therefore illustrates how behavioral traits associated with exudate feeding may also facilitate opportunistic exploitation of prey encountered on trunks or nearby vegetation.

The individual handled the prey against the trunk while feeding, and the photographic sequence captured both dorsal and ventral wing surfaces of the butterfly (Figure 2A–D). The marmoset consumed the body of the butterfly and subsequently part of the wings. Based on wing shape and color pattern, the prey was identified as a blue-banded *Morpho* butterfly, *Morpho* sp. The photographs are consistent with more than one closely similar species, particularly *Morpho achilles* and *M. helenor*, both of which have been recorded in Acre, Brazil (Mielke et al. 2010). However, the available images do not allow reliable species-level identification; therefore, the prey is conservatively retained as *Morpho* sp.



Figure 2: Predation on *Morpho* sp. by a free-ranging *Cebuella niveiventris* in the Zoobotanical Park of the Federal University of Acre, Rio Branco, Acre, Brazil. (A) Individual clinging vertically to a tree trunk while handling the butterfly prey. (B) Closer view of the individual handling the prey against the trunk. (C) Dorsal wing surface visible during feeding. (D) Ventral wing surface visible, supporting identification of the prey as a blue-banded *Morpho*. Because the photographs are consistent with more than one closely similar species, including *Morpho achilles* and *M. helenor*, the prey is conservatively identified as *Morpho* sp.

The visibility of both wing surfaces allowed a more refined identification than is usually possible in field observations of arthropod consumption by pygmy marmosets. Rather than assigning the prey only to Lepidoptera or to a broad insect category, the photographic record allowed recognition of the prey as a member of the genus *Morpho*. This level of identification is important because arthropod prey are often treated as interchangeable food items in primate dietary summaries, even though different insect groups may vary substantially in size,

mobility, defensive traits, nutrient content, exoskeleton content, and availability (Rothman et al. 2014; Reeves et al. 2021).

A large butterfly such as *Morpho* represents a different type of prey from small insects or larvae and may require different capture and handling conditions. This is relevant because blue-banded *Morpho* butterflies in Amazonia belong to a complex of closely related and often sympatric species with similar wing patterns, including *Morpho achilles* and *M. helenor* (Mielke et al. 2010; Bastide et al. 2023). Recent work suggests that the coexistence of sympatric *Morpho* species may be associated with convergent wing morphology combined with ecological and phenological differences. Their bright iridescent dorsal surfaces, cryptic ventral coloration, and rapid, irregular flight may also reduce capture success by visually oriented predators (Le Roy et al. 2021; Bastide et al. 2023). In this context, the present observation is informative because it shows that these traits do not eliminate predation risk once a butterfly is successfully captured by a small arboreal primate.

Many Neotropical Lepidoptera possess secondary compounds involved in antipredator defense, which may reduce palatability to vertebrate predators (Trigo 2000). The present record shows that a blue-banded *Morpho* was nonetheless consumed by *C. niveiventris* under field conditions, with the individual ingesting the body and at least part of the wings. Although based on a single field observation, this event suggests that presumed defensive traits do not necessarily prevent predation and that large butterflies may occasionally be incorporated into the diet of pygmy marmosets.

The handling sequence is also noteworthy because the marmoset did not immediately discard the prey after initial contact. Instead,

the individual consumed the butterfly body and subsequently part of the wings, indicating that at least some parts of the prey were acceptable under the observed conditions. This does not allow conclusions about prey preference or palatability in general, but it shows that butterflies with conspicuous wing coloration can be processed and consumed by *C. niveiventris* when encountered or captured.

Although the photographic sequence provides clear evidence of consumption, the observation does not allow us to determine whether the butterfly was actively captured by the marmoset or obtained after becoming vulnerable on the trunk or nearby vegetation. Therefore, this record should not be interpreted as evidence of regular predation on *Morpho* butterflies or prey preference. Instead, it documents that large Lepidoptera can be consumed by *C. niveiventris* under natural field conditions and highlights a prey category that may be underestimated in behavioral studies.

More broadly, this record adds to a still limited body of detailed natural history information on pygmy marmosets. Unusual predation events have previously been reported for the group, including lizard predation in the southwestern Brazilian Amazon (Guilherme et al. 2016). The present record extends this evidence by documenting predation on a large butterfly with finer taxonomic resolution than is typically achieved in field studies of arthropod consumption. Additional photographic records and direct observations may help clarify whether large butterflies such as *Morpho* represent genuinely rare prey or are simply underreported because feeding events are brief, canopy-associated, and difficult to document in detail.

This distinction between rarity and underreporting is central to interpreting natural history records. A single observation cannot establish frequency, but it can reveal the existence of a trophic interaction that may otherwise remain invisible in quantitative behavioral datasets. Scan sampling is effective for describing activity budgets and broad dietary categories, but rare feeding events may occur between scans or may be recorded only as general feeding behavior if the prey is not visible. For this reason, photographic records should be viewed as complementary to systematic sampling rather than as anecdotal substitutes for it, especially because natural history observations remain fundamental for documenting organisms, behaviors, and ecological interactions in field contexts (Greene 2005; Tewksbury et al. 2014).

It is important to note that much of the earlier ecological literature on pygmy marmosets refers to *Cebuella pygmaea* sensu lato, before the current taxonomic arrangement recognizing *C. niveiventris* for populations south of the Solimões-Amazonas/Napo system. Therefore, comparisons with earlier dietary and behavioral studies are interpreted here as referring to pygmy marmosets broadly, while the Acre population is treated as *C. niveiventris* following recent taxonomic revisions (Garbino et al. 2019; Porter et al. 2023).

This taxonomic clarification is relevant because the interpretation of the present record depends on both the direct observation of *C. niveiventris* in Acre and the broader ecological literature available for pygmy marmosets. In this context, the exudate-feeding records obtained from the same group provide an important behavioral baseline for understanding the predation event. They show that the monitored animals were using vertical trunks and gouged surfaces in a manner consistent with the typical exudate-centered foraging

ecology described for pygmy marmosets, while also occasionally incorporating animal prey into the diet.

Photographic records obtained during the broader field study documented the same group feeding on plant exudates at gouged trees, consistent with the predominantly exudativorous feeding ecology of *C. niveiventris* (Figure 3A–D). These complementary records contextualize the butterfly predation event within the wider feeding repertoire of the monitored group and provide a visual baseline for interpreting the predation record within the species' usual foraging routine. In this sense, Figure 3 is not presented as evidence of additional predation events, but as ecological context showing the vertical substrates, gouged surfaces, and feeding postures commonly used by the monitored group.

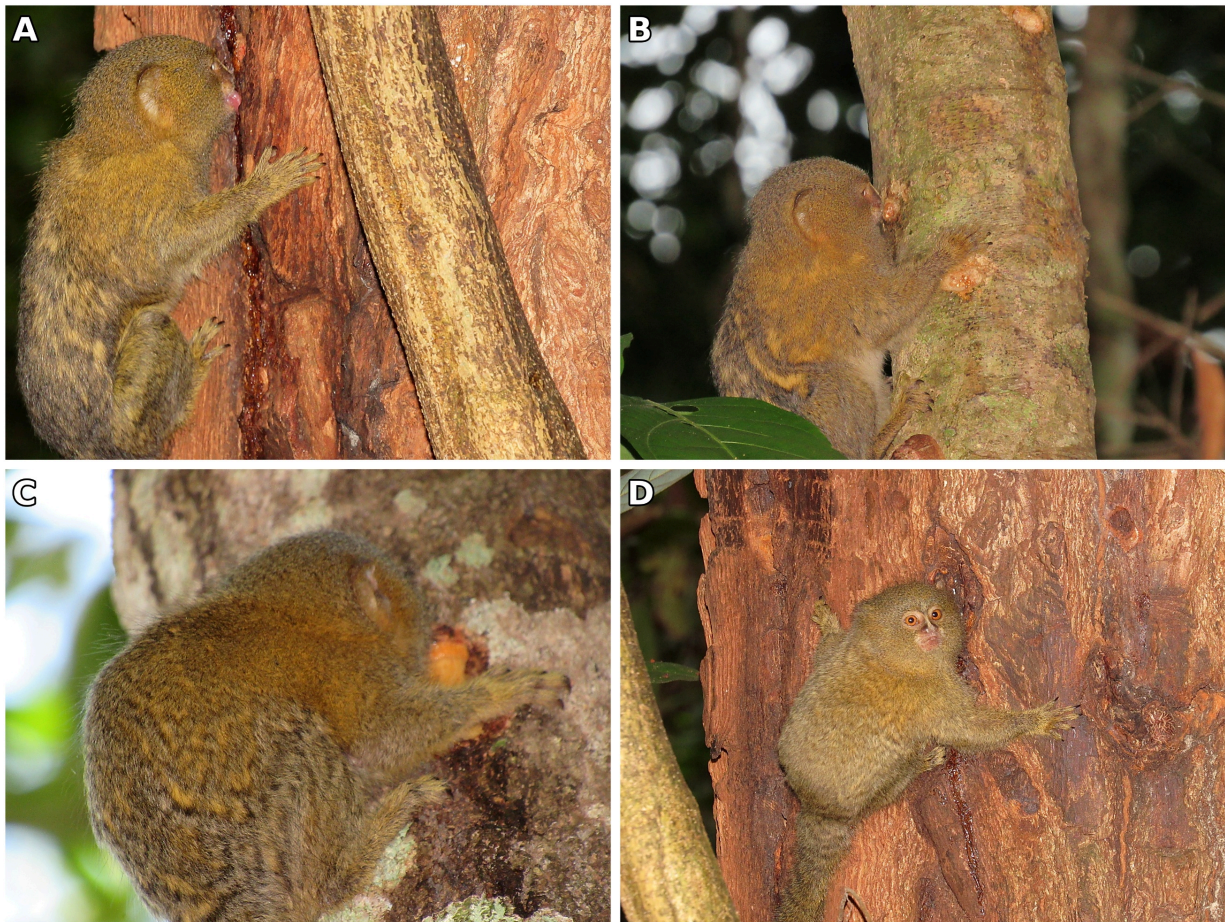


Figure 3: Representative records of exudate feeding by the monitored group of *Cebuella niveiventris* in the Zoobotanical Park of the Federal University of Acre, Rio Branco, Acre, Brazil. (A) Individual licking exudate from a gouged tree trunk. (B) Individual feeding at active gouge sites on the trunk. (C) Close view of exudate feeding on a gouged surface. (D) Individual positioned at an exudate-feeding site on a gouged trunk. These images illustrate the typical exudativorous feeding behavior of the species and provide ecological context for the butterfly predation event reported here.

The exudate-feeding photographs are therefore important because they show that butterfly consumption occurred within the species' usual spatial and behavioral routine, rather than indicating a broader shift in diet. This interpretation is consistent with classic dietary studies on pygmy marmosets and with more recent evidence suggesting that repeated exudate feeding can stimulate exudate production, further emphasizing the central role of gouged trees in pygmy marmoset foraging ecology (Ramirez et al. 1977; Soini 1982; Jackson and Reichard 2021). The present event is therefore best interpreted as an occasional supplement to an otherwise exudate-centered diet.

The observation also reinforces the idea that exudate-feeding sites and arboreal substrates may serve as contexts in which other food resources are encountered. Trees used for gouging and exudate feeding may attract insects directly or indirectly, and trunk surfaces can provide both travel routes and foraging substrates. Although the present record does not show whether the butterfly was captured on the trunk, in flight, or from nearby vegetation, it demonstrates that prey handling can occur in the same vertical microhabitats routinely used by pygmy marmosets during exudate-related activities.

The fact that the event was recorded in a trail section with frequent pedestrian traffic should be interpreted cautiously. Recent work with *C. niveiventris* in the Peruvian Amazon found little evidence that anthropogenic noise consistently alters pygmy marmoset behavior, suggesting that responses to human disturbance may be context-dependent and influenced by local conditions (Hawkins and Papworth 2022). Accordingly, the present record should not be interpreted as evidence that human presence influenced prey choice. Instead, it demonstrates that uncommon trophic interactions can be documented even in accessible urban forest fragments, where repeated monitoring increases the likelihood of recording brief and easily missed feeding events.

Urban forest fragments, although often affected by edge effects, habitat simplification, and frequent human presence, may function as important observation sites for documenting poorly known behavioral interactions. In the Brazilian Amazon, forest fragments can still support native primate populations, although primate occurrence depends on landscape context, fragment characteristics, and species traits (Boyle and Smith 2010). In the present case, the

accessibility of the Zoobotanical Park and the repeated monitoring of a resident group of *C. niveiventris* increased the likelihood of recording a brief feeding event that might otherwise have gone unnoticed. Thus, observations from urban forest fragments should not be dismissed as anecdotal or marginal; instead, when properly documented and interpreted cautiously, they can contribute valuable information to the natural history of small Neotropical primates.

Such records are also relevant for local conservation and environmental education. Urban forest fragments embedded in university campuses or city landscapes may support resident populations of small primates and maintain ecological interactions that are rarely observed by the public. Documenting these interactions helps demonstrate that even disturbed or accessible fragments can retain biological value, provided that observations are interpreted in light of habitat context and sampling limitations.

4. FINAL CONSIDERATIONS

We report the first photographic record of predation on a blue-banded *Morpho* butterfly by the eastern pygmy marmoset, *Cebuella niveiventris*, in southwestern Amazonia. The photographic sequence allowed the prey to be identified as *Morpho* sp., although species-level identification was not possible. This record expands the known trophic repertoire of *C. niveiventris* and supports the interpretation that arthropod prey, including large Lepidoptera, may be used opportunistically as a dietary supplement by an otherwise exudate-specialized primate.

Beyond documenting a single feeding event, this observation highlights the importance of long-term field monitoring and photographic documentation for natural history studies. Brief interactions involving small arboreal primates are easily missed, and photographs can provide critical evidence for refining prey identification and interpreting feeding behavior, reinforcing the broader value of natural history records for ecology, conservation, and behavioral biology (Greene 2005; Tewksbury et al. 2014). In this case, the photographic sequence was essential for recognizing the prey as *Morpho* sp. and for avoiding a less informative classification such as “insect” or “Lepidoptera.”

Continued documentation of opportunistic predation events will help improve understanding of prey diversity, foraging flexibility, and trophic interactions in pygmy marmosets and other small Neotropical primates. Future studies combining systematic behavioral sampling with photographic evidence and, when possible, more detailed identification of prey items may clarify whether large butterflies are rare components of the diet or simply overlooked in conventional field observations.

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