

## ORIGINAL ARTICLE

# Predation and Hematophagy at Mineral Licks in the Western Amazon

Sam Pottie<sup>1</sup>  | Gladys Tapara<sup>1</sup> | Erin Marcela Rivera Groves<sup>1</sup>  | Raul Bello<sup>2</sup> | Rachel Kilby<sup>3</sup> | Jessica Ortiz<sup>1</sup>  | Adrian Forsyth<sup>1</sup> 

<sup>1</sup>Climate Corridors, Washington, District of Columbia, USA | <sup>2</sup>Kawsay Biological Station, Puerto Maldonado, Peru | <sup>3</sup>Taricaya Ecological Reserve, Madre de Dios, Peru

**Correspondence:** Sam Pottie ([sam.pottie@hotmail.com](mailto:sam.pottie@hotmail.com))

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## ABSTRACT

In tropical rainforest ecosystems, where prey is widely dispersed and difficult to detect, predictable congregation sites offer rare and valuable hunting opportunities. Mineral licks represent such hotspots, attracting a diverse array of herbivores seeking mineral- and clay-rich soils. Here, we report observational data on predator–prey interactions and hematophagy at mineral licks, based on 5693 trap-days across 19 mineral licks using 56 camera traps. We documented 75 predator–prey interactions and 22 cases of hematophagy involving a diverse array of taxa. Predation events mainly recorded non-terrestrial prey species—particularly bats, followed by arboreal mammals and birds. All confirmed successful predation events involved these taxa, suggesting that mineral licks may function as significant mortality factors for volant and arboreal species descending to the ground. Hematophagy was exclusively carried out by the common vampire bat (*Desmodus rotundus*), primarily targeting lowland tapirs (*Tapirus terrestris*). This species may be especially vulnerable due to its large body size, slow movements, and prolonged periods of immobility while engaging in geophagy. Among the observed predators, reptiles—particularly Amazon tree boas (*Corallus hortulanus*)—were the most frequently observed, while ocelots (*Leopardus pardalis*) exhibited the broadest prey spectrum. These findings highlight mineral licks as focal points of predator–prey activity in Amazonian forests, revealing poorly documented patterns of antagonistic interactions.

## RESUMEN

En los bosques tropicales, donde las presas están ampliamente dispersas y son difíciles de detectar, los sitios de congregación predecibles ofrecen oportunidades de caza raras y valiosas. Los collpas o saladeros representan este tipo de puntos críticos, atrayendo una gran diversidad de herbívoros que buscan suelos ricos en minerales y arcillas. En este estudio, presentamos datos observacionales sobre interacciones depredador–presa y hematofagia en collpas, basados en 5693 días-trampa en 19 collpas utilizando 56 cámaras trampa. Documentamos 75 interacciones depredador–presa y 22 casos de hematofagia que involucraron un amplio espectro taxonómico. Los eventos de depredación registraron principalmente presas no terrestres, especialmente murciélagos, seguidos por mamíferos arborícolas y aves. Todos los eventos de depredación exitosos confirmados involucraron estos grupos, lo que sugiere que las collpas pueden funcionar como importantes factores de mortalidad para especies voladoras y arborícolas al descender al suelo. La hematofagia fue realizada exclusivamente por el murciélago vampiro común (*Desmodus rotundus*), principalmente sobre tapires de tierras

bajas (*Tapirus terrestris*). Esta especie puede ser particularmente vulnerable debido a su gran tamaño corporal, movimientos lentos y periodos prolongados de inmovilidad mientras realiza geofagia. Entre los depredadores observados, los reptiles —en particular la boa arborícola amazónica (*Corallus hortulanus*)— fueron los más frecuentes, mientras que el ocelote (*Leopardus pardalis*) presentó el espectro de presas más amplio. Nuestros resultados resaltan a las collpas como puntos focales de actividad depredador–presa en los bosques amazónicos, revelando patrones poco documentados de interacciones antagonistas.

## 1 | Introduction

In tropical rainforest ecosystems, most mammalian predators are solitary and rely on strategies to locate widely dispersed and unpredictable prey (Carrillo et al. 2009; Emmons 1987). Ambush tactics, such as those employed by jaguars (*Panthera onca*), allow predators to minimize the energetic cost of hunting in environments with low prey visibility (Weckel et al. 2005). In these systems, locations where prey predictably congregate offer especially valuable hunting opportunities. Such aggregations often form around localized resources, including fruiting trees and water sources, and can influence prey communities through fear-driven behavioral changes, with cascading effects across trophic levels and ecosystem functioning (Breviglieri et al. 2017). In the western Amazon, one of the most important examples of such aggregation sites are mineral licks (Macas-Pogo et al. 2023).

Mineral licks, also called collpas in Peru, are naturally occurring sites where animals engage in geophagy—the consumption of soil—to obtain minerals, such as sodium, to supplement their diet (Dudley et al. 2012; Holdo et al. 2002). Additionally, geophagy may serve a detoxification function, as the high clay content of these soils—particularly kaolinite—helps bind and neutralize secondary plant compounds in the gut (Gilardi et al. 1999; Oates 1978). While rare in most ecosystems, these sites are relatively abundant in the western Amazon lowlands and attract a wide variety of medium- to large-bodied herbivorous mammals and birds (Lee et al. 2010; Montenegro 2004; Molina et al. 2018).

Although mineral licks provide essential resources, they also pose significant risks, as the high concentration of prey species appears to increase exposure to predation, parasitism, and conflict over mineral lick access (Griffiths, Gilmore, and Bowler 2020; Severud et al. 2023). In rare cases, such competition can be fatal—Bello et al. (2022) reported collared peccaries (*Dicotyles tajacu*) attacking and killing a howler monkey (*Alouatta sara*) at a mineral lick. For herbivores, mineral licks present an ecological trade-off, where the benefits of acquiring essential minerals or detoxifying clays must be weighed against the risks of predation and parasitism. Many prey species thus exhibit anti-predation strategies at mineral licks, such as displaying vigilance, consuming collected soil *ex situ*, forming interspecies groups, or timing their visits to avoid overcast or rainy conditions, as well as certain lunar phases, that reduce visibility and auditory awareness (Griffiths, Bowler, et al. 2020; Link et al. 2011; McGraw and Bshary 2002; Pottie et al. 2023). These behavioral adaptations have been mostly documented in arboreal mammals as they face significant risks at these terrestrial sites due to their apparent increased vulnerability at ground level (Janson 1998; Matsuda and Izawa 2008).

While prey species attempt to minimize risks, predators appear to actively exploit mineral licks, as the predictable presence of

prey at these mineral-rich hotspots offers a rare opportunity for predators to ambush their otherwise elusive targets (Bastidas-Dominguez et al. 2023; Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Macas-Pogo et al. 2023; Matsuda and Izawa 2008). Additionally, parasites such as the common vampire bat (*Desmodus rotundus*) may use these sites to locate and feed on hosts, as the prolonged, relatively immobile presence of large-bodied mammals during geophagy may facilitate hematophagous feeding (Castellanos and Banega 2015).

Given the high concentration of both predators and prey, mineral licks offer a unique opportunity to study predator–prey dynamics in the Amazon, where data on such interactions remain scarce (Griffiths et al. 2025). This scarcity is largely due to the dense vegetation and the elusive nature of rainforest species, which make these interactions difficult to observe and document (Ferrari 2009). The use of camera traps at mineral licks can help overcome this challenge by providing continuous, non-invasive monitoring of species interactions (Tobler et al. 2009). However, the unique ecological conditions at these sites may lead to species interactions that are less frequent or even absent elsewhere in the forest, and thus may not fully represent typical predator–prey dynamics. Nonetheless, mineral licks serve as valuable natural laboratories for detecting and analyzing rare events that would otherwise be nearly impossible to observe.

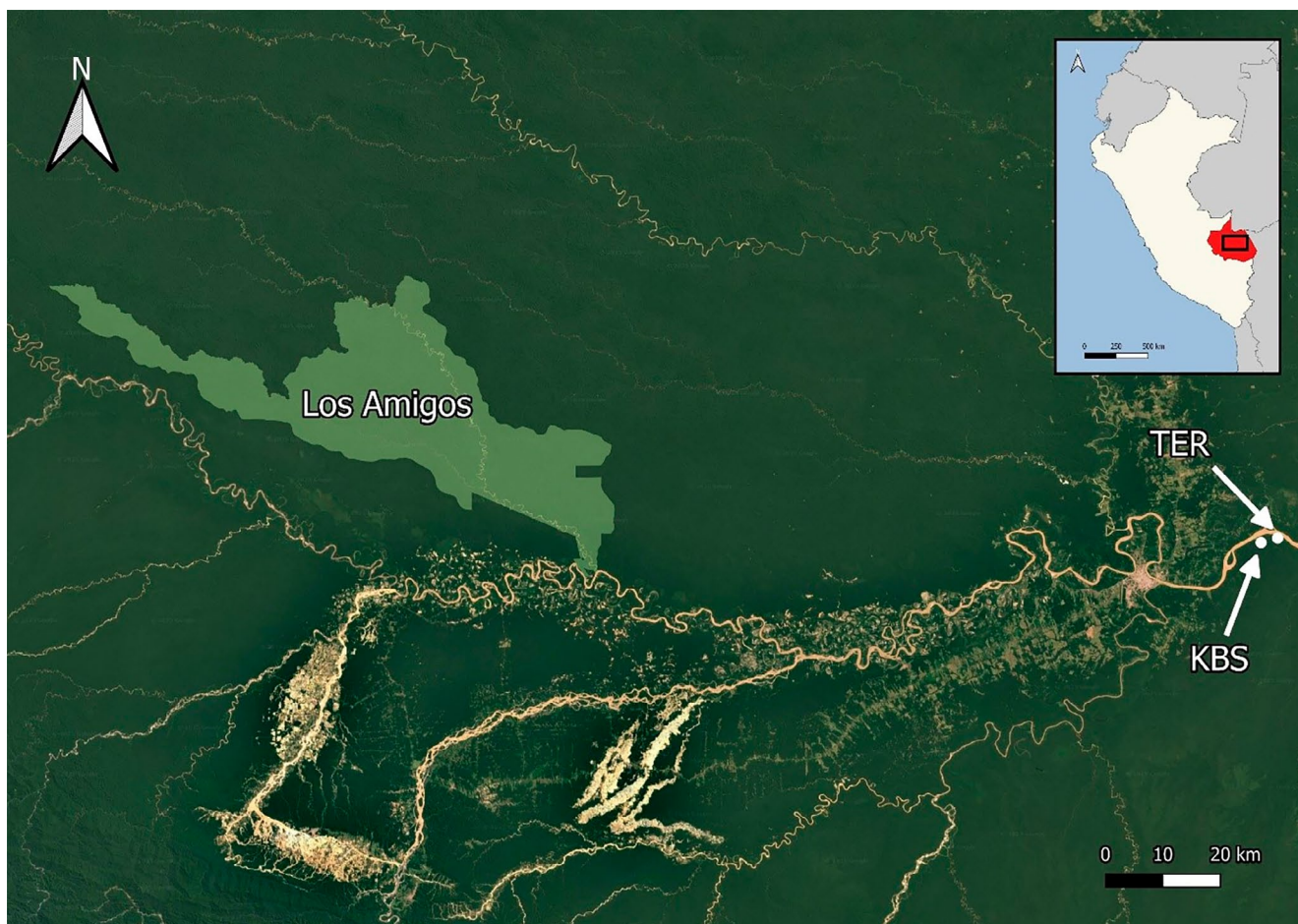
Surprisingly, predator–prey interactions at mineral licks remain poorly studied (Griffiths et al. 2025). Most existing research consists of isolated observations based on still imagery (Bastidas-Dominguez et al. 2023; Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Matsuda and Izawa 2008). In contrast, our survey used video-based camera trapping at a substantial number of mineral licks, allowing us to obtain a large sample of predator–prey interactions.

This study reports predator–prey interactions at mineral licks, as well as instances of hematophagy, and identifies the key taxa involved in these interactions, with a focus on detecting potential patterns in their occurrence. Through this approach, we contribute to a deeper understanding of the ecological significance of mineral licks beyond their role as mineral-rich foraging sites.

## 2 | Methods

### 2.1 | Study Sites

This study includes camera trap data from mineral licks at three sites in southeastern Peru: Los Amigos, Kawsay Biological Station (KBS), and Taricaya Ecological Reserve (TER) (Figure 1).



**FIGURE 1** | Map of the study sites in southeastern Peru.

These sites encompass a range of habitat types within the lowland Amazon rainforest of southeastern Peru.

### 2.1.1 | Los Amigos

Los Amigos encompasses the Los Amigos Conservation Concession (LACC) and the Los Amigos Biological Station (LABS), both situated in the department of Madre de Dios, Peru. LACC and LABS are adjacent to each other and both located at the confluence of the Madre de Dios and Los Amigos Rivers. LACC covers approximately 146,000 ha, while LABS spans 452 ha. The elevation at LA is approximately 250 m a.s.l., supporting a variety of habitats, including terra firme forests, seasonally flooded várzea forests, oxbow lakes, bamboo thickets, and palm swamps. The region experiences a humid tropical climate with an annual rainfall of approximately 2500 mm. The dry season extends from June to September, while the rainy season lasts from October to May. Temperatures range from 20°C to 32°C (Whitworth et al. 2022).

### 2.1.2 | Kawsay Biological Station

Kawsay Biological Station (KBS) is located in the buffer zone of the Tambopata National Reserve, along the southern bank of the lower Madre de Dios river. The habitat at KBS consists of seasonally

flooded primary subtropical wet forest, as classified under the Holdridge life zone system (Holdridge 1967). The climate in this region is characterized by two distinct seasons: a dry season from May to October and a wet season from November to April. The historical average annual rainfall is 2297 mm, with strong seasonal variation, ranging from approximately 30 mm in the driest month to around 400 mm in the wettest month. The average annual temperature is 31.3°C, with the highest temperatures typically recorded in September and the lowest in May (SENAMHI 2016).

### 2.1.3 | Taricaya Ecological Reserve

Taricaya Ecological Reserve (TER) is a 476 ha privately owned reserve, also located in the buffer zone of the Tambopata National Reserve. TER consists of seasonally flooded primary subtropical wet forest, as classified by the Holdridge life zone system (Holdridge 1967). This site has a similar climate as KBS.

## 2.2 | Camera Trap Deployment

### 2.2.1 | Los Amigos

Between December 2023 and February 2024 (wet season) and between June 2024 and October 2024 (dry season), a total of 53 Browning StrikeForce camera traps were deployed to monitor 16

mineral licks within the Los Amigos Conservation Concession (LACC) and Los Amigos Biological Station (LABS). The number of camera traps installed at each mineral lick was determined by its size, with larger mineral licks requiring more cameras for effective monitoring, ranging from one to eight camera traps per site. These camera traps were positioned to maximize their field of view over areas with the presumed highest geophagy activity. They were programmed with a 1-min interval between motion-triggered recordings. However, due to a malfunction, some nocturnal video recordings were shortened to 1–5s instead of the intended 20s. Despite this issue, species identification remained possible.

### 2.2.2 | Kawsay Biological Station

Between April 2018 and September 2021, Bushnell camera traps (Trophy HD Aggressor) were deployed at two mineral lick sites within KBS. Camera traps were positioned 30cm above the ground at a slight downward angle to ensure full coverage of the mineral licks. Camera traps were programmed to record 10-s videos upon motion detection, with a 3-s interval between consecutive recordings.

### 2.2.3 | Taricaya Ecological Reserve

At Taricaya Ecological Reserve, one mineral lick was monitored intermittently using two Trophy HD Aggressor (Bushnell, Overland Park, KS) camera traps between March 2016 and December 2024. Camera traps were deployed periodically throughout this time-frame as part of ongoing research within the reserve. Cameras were programmed to record videos lasting 20s upon motion detection, with a 10-s interval between consecutive recordings.

## 2.3 | Data Processing

### 2.3.1 | Independent Event Criteria

Due to the varying sizes of mineral licks, some required up to 10 camera traps for comprehensive monitoring. However, for the calculation of independent events, all camera traps at the same mineral lick were considered dependent on one another. To distinguish independent events within a single mineral lick, we applied a 6-h cutoff rather than the more commonly used 30-min interval. This extended timeframe was chosen due to the rarity of predation and attempted predation events, which increased the likelihood that repeated detections within a short period involved the same individual predator. Additionally, reptiles were among the observed predators, but due to their lower activity levels and reduced thermal signatures, they were less frequently detected by motion-triggered camera traps than endothermic species like mammals and birds. By using a 6-h cutoff, we aimed to minimize the risk of counting the same hunting event multiple times while ensuring that distinct interactions were treated as separate events.

### 2.3.2 | Event Classification

Each recorded interaction between predators/parasites and prey was categorized into one of four behavioral classifications based

on a thorough analysis of the camera trap footage. “Successful Predation” was assigned when a predator was observed actively capturing and killing its prey at a mineral lick, or when it was seen at the lick with already-captured prey in its possession. If a predator and potential prey were observed together at a mineral lick and the event ended without a successful capture—such as when the prey moved away or otherwise avoided the predator—it was classified as “Attempted Predation”. “Successful Hematophagy” was recorded when a parasite was observed actively feeding on or exploiting its host without the host detecting or resisting the interaction. Events were classified as “Attempted Hematophagy” when a parasite was detected and actively repelled by its host before successfully establishing contact. Both “Attempted Predation” and “Attempted Hematophagy” should be interpreted with caution, as interactions may have continued beyond the initial observation. Subsequent attempts within the 6-h time frame could have occurred outside the camera's field of view or after recording ended, meaning that some events recorded as unsuccessful may ultimately have resulted in successful capture or hematophagy.

### 2.3.3 | Species Identification

Species identification was conducted through careful video analysis, using morphological characteristics to distinguish between species. When possible, identification was cross-referenced with existing field guides and validated by experts. In cases where species-level identification was not feasible due to video quality or limited distinguishing features, individuals were identified to the highest possible taxonomic level.

## 3 | Results

We monitored 19 mineral licks with 56 camera traps, resulting in a total survey effort of 5693 trap-days. During this period, we recorded 97 events involving predators or parasites and prey. These included 75 predator–prey interactions, of which 14 consisted of successful predation events, and 22 hematophagic interactions, of which 11 were successful. We identified five predator taxa: two felids (*Panthera onca* and *Leopardus pardalis*), one hawk (*Rupornis magnirostris*) and two reptiles (*Corallus hortulanus* and *Paleosuchus* sp.). Hematophagy was exclusively recorded from the common vampire bat (*Desmodus rotundus*), which targeted the lowland tapir (*Tapirus terrestris*), with the single exception of an event involving a capybara (*Hydrochoerus hydrochaeris*).

Predator–prey interactions at mineral licks were most frequently associated with Amazon tree boas hunting bats (Figure 2). Dwarf caimans were also observed preying on bats, although this interaction was restricted to a single site. Ocelots exhibited both the highest capture rate and the greatest prey diversity, targeting parakeets, bats, primates, rodents, and deer. Jaguars were recorded in two unsuccessful predation attempts on collared peccaries (*Dicotyles tajacu*). A single unsuccessful predation event by a roadside hawk on a pigeon or dove (Columbidae) was also documented. A summary of all predator taxa involved in observed predator–prey interactions, including their frequency, capture rate, and site occupancy, is provided in Table 1.

Across all recorded events, bats were the most frequently recorded prey group, hunted by a variety of predator species and documented at multiple mineral licks. Parakeets, along with howler monkeys (*Alouatta sara*), were also successfully predated upon on more than one occasion. Because the howler monkey cases represent particularly notable and rarely documented events at mineral licks, we provide additional detail here. In the first event, a large adult male howler monkey was seized by an adult ocelot (sex undetermined) but broke free after a brief struggle lasting only a few seconds; the ocelot fled and was pursued by the howler. In the second event, an adult male ocelot was observed dragging an adult howler monkey (sex undetermined) by the throat. The third event shows an adult ocelot attacking a howler monkey, clinging to it from underneath and pulling it downward as the howler vocalizes. In the final clip, the ocelot drags the howler to the ground, apparently killing it. Single successful predation events were also recorded on a bicolor-spined porcupine (*Coendou bicolor*) and a pigeon or dove (Columbidae). In contrast, predation attempts on collared peccaries (*Dicotyles tajacu*) and red brocket deer (*Mazama americana*) were observed but were not successful.

Hematophagic events were observed at 37% of all monitored mineral licks and exclusively occurred between common vampire bats and lowland tapirs, except for a single event in which the host was



**FIGURE 2** | Screenshot of a camera-trap video of an Amazon tree boa hunting bats at a mineral lick.

a capybara. Unsuccessful attempts occurred when the tapir detected the approaching bat in time, responding by either attempting to stomp on it when it landed on the ground or making abrupt movements to evade it while it circled overhead, trying to land. Successful hematophagy was observed in three distinct regions of the tapir's body: the upper back, the lower dorsolateral lumbar region and the plantar venous plexus of the heel (Figure 3).

#### 4 | Discussion

Predator–prey interactions at mineral licks have previously been reported as isolated predation events, often within broader monitoring efforts (Bastidas-Dominguez et al. 2023; Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Matsuda and Izawa 2008). While these reports provide valuable insights into predator–prey interactions at mineral licks, they are generally limited in scope, focusing on individual occurrences. To our knowledge, this study provides the most extensive documentation to date of predator–prey interactions at Amazonian mineral licks, based on camera trap video footage collected across a large number of sites over an extended survey period. Our findings therefore offer a comprehensive understanding of how mineral



**FIGURE 3** | Screenshot of a camera trap video of a common vampire bat licking blood from a tapir's heel at a mineral lick.

**TABLE 1** | Predator–prey interactions at mineral licks, with prey species targeted, event frequency, capture rates, and site occupancy.

Predator (scientific name)	Prey (scientific name)	Events	Relative frequency (%)	Capture rate (%)	Site occupancy (%)
<i>Corallus hortulanus</i>	Chiroptera	35	46.7	6.0	10.5
<i>Paleosuchus</i> sp.	Chiroptera	19	25.3	0.0	5.3
<i>Leopardus pardalis</i>	<i>Pyrrhura</i> spp.	3	4.0	66.7	10.5
<i>Leopardus pardalis</i>	Chiroptera	9	12.2	66.7	5.3
<i>Leopardus pardalis</i>	<i>Alouatta sara</i>	3	4.0	66.7	10.5
<i>Leopardus pardalis</i>	<i>Coendou bicolor</i>	1	1.3	100	5.3
<i>Leopardus pardalis</i>	<i>Mazama americana</i>	1	1.3	0.0	5.3
<i>Panthera onca</i>	<i>Dicotyles tajacu</i>	2	2.7	0.0	10.5
<i>Buteo magnirostris</i>	Columbidae	1	2.7	50.0	10.5

licks function not only as feeding and gathering points but also as ecological hotspots for predator–prey encounters.

One of the most notable patterns to emerge from our data is the vulnerability of non-terrestrial species to predation at mineral licks. All successful predation events involved non-terrestrial taxa—specifically birds, bats, and arboreal mammals. In contrast, terrestrial species such as tapirs, deer, and peccaries, though frequently recorded at mineral licks, were not observed being successfully predated upon. While collared peccaries (two events) and a red brocket deer (one event) were targeted, they consistently managed to evade capture. Although our sample size for interactions with terrestrial prey was small, it may reflect these species being better adapted to detect and/or escape ground-based ambush predators (dos Santos et al. 2024; Lundgren and Moeller 2017). Conversely, non-terrestrial species may be at a disadvantage when descending to the forest floor to access mineral licks, as they are not as agile at ground level to avoid predators, making them easier targets (Janson 1998; Monteza-Moreno et al. 2020). These risks are reflected in the behavior of arboreal prey species, which exhibit several adaptations to reduce predation risk when visiting mineral licks (Griffiths et al. 2025). These include increased vigilance before and during descent, avoidance of geophagy during bright moonlit nights by nocturnal species, a preference among diurnal species for visiting during the hottest hours of sunny days—periods when predator activity tends to be lower and visibility is higher—and descending in larger groups, which likely enhances collective predator detection and reduces individual vulnerability (Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Izawa 1993; Link et al. 2011). Nonetheless, despite these strategies, the repeated success of predators targeting arboreal and volant prey at mineral licks indicates that these sites present high predation risk for non-terrestrial species (Bastidas-Dominguez et al. 2023; Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Macas-Pogo et al. 2023; Matsuda and Izawa 2008).

Among these, bats stood out as the most frequently predated-upon taxon in our dataset, representing one of the most striking examples of their vulnerability to predation at mineral licks. Previous research at Los Amigos suggests that the bats most frequently observed at these specific sites are pregnant and lactating members of the subfamily Stenodermatinae, which typically visit mineral licks to drink sodium-enriched water rather than consume soil directly (Bravo et al. 2008, 2012). Our observations align with this, as all recorded predation events involving bats occurred at mineral licks that had standing water. The resulting presence of standing water may therefore not only facilitate geophagy in bats but also increase their exposure to predators. Bats may therefore rely on a strategy of safety in numbers, as our recordings frequently showed large groups circling above the mineral lick and swooping down to drink in rapid succession (Bravo et al. 2010). While this group behavior may reduce the likelihood of any individual being captured, it likely increases the overall probability of a successful capture for predators (Hamilton 1971). Our data reveal three distinct hunting strategies employed by predators targeting bats at flooded mineral licks. First, predators such as Amazon tree boas and dwarf caimans were observed striking at bats mid-air as they passed too closely, while ocelots were seen swatting bats out of the air and then pouncing on them once grounded. Second, ocelots were recorded pouncing directly on bats at the lowest point of

their swoop as they dipped to drink from the mineral lick water. Third, in several instances, bats appeared to miscalculate their descent and became stuck in the mud, rendering them unable to escape and easily captured by ocelots. These observations suggest that flooded mineral licks provide highly predictable opportunities for predators to exploit bats using diverse strategies.

Surprisingly, reptiles—a taxa not previously documented as predators at mineral licks—accounted for the majority of observed predator–prey interactions, in contrast to mammals, which have previously been recorded as predators at these sites (Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Izawa 1993; Matsuda and Izawa 2008). These reptiles, specifically the Amazon tree boa (*Corallus hortulanus*) and dwarf caiman (*Paleosuchus* sp.), exclusively targeted bats. The predictable and concentrated activity of bats at flooded licks likely offers an energetically efficient hunting opportunity for these ectothermic predators, which are physiologically better suited to remain stationary for extended periods, striking only when prey flies within range (Hanscom et al. 2023). Moreover, studies on other ambush-foraging reptiles, such as timber rattlesnakes (*Crotalus horridus*), have demonstrated that such predators can refine ambush site selection based on chemical cues and prior feeding experience, enhancing foraging efficiency through learned behavior (Clark 2004). In contrast, endothermic predators—such as felids—are better adapted to active stalking and pouncing strategies, as their high metabolic rates render prolonged ambush energetically costly (Williams et al. 2014). Nevertheless, we did record several instances of ocelots (*Leopardus pardalis*) successfully hunting bats at flooded mineral licks, indicating that mammalian predators may occasionally exploit this resource as well.

Although reptiles accounted for the greatest number of predator–prey interactions at mineral licks, the ocelot—a mammalian predator—had the highest capture rate. This may reflect its ability to exploit a wide variety of prey species at mineral licks (Griffiths, Bowler, et al. 2020; Griffiths, Gilmore, and Bowler 2020; Macas-Pogo et al. 2023), including arboreal and volant taxa that are especially vulnerable while foraging at ground level (Bastidas-Dominguez et al. 2023; Izawa 1993; Link et al. 2011; Matsuda and Izawa 2008). Its medium body size likely plays a key role in this, providing the agility and stealth needed to effectively pursue these smaller, less agile targets (Moreno et al. 2006). In contrast, larger predators like jaguars and pumas tend to focus on bigger terrestrial species, such as peccaries and deer, which offer a higher energetic return but are also better adapted to evade predators at these sites (Rueda et al. 2013). The ocelot's hunting success at mineral licks may therefore stem from its ability to exploit a broad range of vulnerable prey taxa. Moreover, ocelots' success at mineral licks may also result from a combination of spatial and temporal strategies aimed at maximizing prey encounters. For example, they have been observed targeting predictable refuges (Emsens et al. 2013) and adjusting their activity patterns to align with those of key prey species (Porfirio et al. 2016). This combination of behavioral flexibility and spatial awareness likely contributes to their apparent hunting efficiency at these sites. However, not all ocelots' predation attempts were successful. In one striking case, an ocelot attacked a large adult male howler monkey, but was ultimately forced to flee, with the howler aggressively pursuing it. This incident may reflect a misjudgment on the part of the ocelot, underestimating the defensive capacity of its target. Such events highlight the risks

involved in targeting larger, more formidable prey, even in a setting that otherwise favors ocelot hunting success.

Hematophagy by common vampire bats (*Desmodus rotundus*) was frequently documented at mineral licks, with numerous events—both successful and unsuccessful—involving lowland tapirs (*Tapirus terrestris*). These interactions were observed across multiple sites, suggesting that tapirs may be regular and predictable hosts for vampire bats in these contexts. Their large body size, relatively slow movement, and prolonged visits to mineral licks likely increase their vulnerability, particularly when they remain stationary or move slowly while consuming soils (Tobler et al. 2009). Notably, the only recorded hematophagy event in which the host was not a tapir involved a three-legged capybara, which was targeted in a similar manner. Although this is a single observation, we recorded numerous other capybaras in good physical condition at mineral licks, none of which showed evidence of vampire bat parasitism. This suggests that reduced mobility—whether due to injury or species-specific traits—may increase vulnerability to hematophagy.

The high frequency of these antagonistic interactions at specific sites may reflect broader ecological dynamics that draw potential hosts to predictable locations, as seen in studies linking vampire bat activity to concentrations of large mammals beneath fruiting trees (De Morais 2024). Similarly, mineral licks appear to serve as reliable foraging grounds for vampire bats, offering consistent access to large-bodied hosts such as tapirs (Castellanos and Banega 2015). For example, in one camera trap recording, a mother tapir and her infant were both being parasitized by vampire bats on their backs at the same time.

These repeated parasitism events were not merely opportunistic but were often preceded by calculated behaviors, reflecting the bats' ability to assess and exploit their hosts strategically. In several instances, for example, vampire bats were observed clinging to nearby tree trunks or to the exposed walls of the mineral licks, watching potential hosts—sometimes for extended periods—before attempting to parasitize. They either landed directly on the tapir's back or positioned themselves just behind the animal on the ground. Similar tactics have been reported in southeastern Brazil, where a vampire bat used mid-level vegetation as a perch and vantage point to launch repeated attempts to land on the tapir's posterior dorsolateral region (Pignaton Gnochchi and Srebek-Araujo 2017). These observations underscore the strategic hunting techniques employed by *D. rotundus* when targeting large-bodied prey.

Tapirs exhibited various defensive behaviors in response to these attempts. They ran away, circled in place to maintain visual contact and prevent the bat from landing, and bucked if a bat managed to land. If the bat was detected on the ground, the tapir attempted to stomp on it with its forefeet. Similar behavioral responses—such as shaking, turning abruptly, and even pursuing bats in flight—have been reported in Central American tapirs confronted by vampire bats (Amit and Valverde-Zuniga 2022). This suggests a widespread behavioral repertoire to deter hematophagy across tapir species.

These results demonstrate that mineral licks serve as natural laboratories for investigating predator–prey interactions and hematophagy in the western Amazon. By attracting a diverse array of

herbivores seeking essential nutrients, mineral licks also draw in predators and parasites, intensifying ecological pressures at these sites (Lavella et al. 2014; Severud et al. 2023). Species with certain traits—such as arboreal or volant habits, large body size, or reduced mobility—may be especially vulnerable during their visits. These patterns highlight the need to consider mineral licks not only as nutritional resources but also as key sites for studying the ecological costs of resource use.

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## Conflicts of Interest

The authors declare no conflicts of interest.

## Data Availability Statement

The data that support the findings of this study are openly available in TIB-AV PORTAL at <https://av.tib.eu/media/70203>, reference number <https://doi.org/10.5446/70203>.

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